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GEOLOGICAL WATER WAYS ACROSS CENTRAL AMERICA.

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Introduction.—From the days of early discovery, adventurers and explorers have repeatedly sought for accessible routes across Central America. For more than half a century engineers have ransacked the dense mountain forests for easy passes through which to connect the two great oceans by water or by rail. The number of low passes which dissect the Cordilleras and plateaus between North and South America is much larger than is popularly known. Indeed, there are so many deep breaks in the plateau regions as to suggest that many of them at no distant date were water ways between the Atlantic and Pacific. On account of the narrowness of the Isthmus of Panama and the low altitude of the divide, this region has been most noticed as a possible geological passageway between the Antillean waters and the Pacific Ocean. But it has been discovered that other water ways across the American continent can be even more surely established, and that neither the narrowness of the Isthmus of Panama nor the lowness of the divide form any additional evidence of the late interoceanic connection.

The early Tertiary period—the time when water connection across Panama had been suggested—was so long ago that the land animals have completely changed their characteristics, and even the sea shells have been mostly transformed into more modern species; accordingly, the time has been sufficiently long for several subsequent changes in the physical barriers between the Atlantic and Pacific. Indeed, geological straits across the continent have existed at differ-

ent epochs since the early Tertiary period, and the last was so recent as to place it almost in modern times.

In searching for the geological water ways, the phenomena of the recent elevation of Mexico and Central America became so apparent as to establish the theory that the uplifting of the American barrier to its great altitude occurred principally since the period when the West Indian islands formed a high plateau bridge between the eastern portions of the two American continents (as described by the writer in The West Indian Bridge between North and South America).* Indeed, the discovery of the recent elevation of Central America and Mexico forms a most important sequel to the story of the now submerged West Indian lands, for it shows that Central America was low at the time when the Antilles stood at a great height—though it has subsequently been elevated, while the eastern region has been largely submerged. The discoveries of these great changes of level in recent periods are the necessary complementary phenomena of those found in the Antillean region.

Physical Features of Mexico and Central America.—*The Table-Lands.*—Much the larger area of Mexico and Central America is occupied by plateaus from six to eight thousand feet above the sea. Indeed, some of them have an altitude of over ten thousand feet. These elevated table-lands rise abruptly for thousands of feet above the inner margins of the coastal plains, which gradually slope upward from the seashores. The elevated plains, traversed by many mountain ridges, are, to the eye, apparently level. Out of their floors there also rise numerous island-like hills called *cerros*, as well as great volcanic cones. Thus the volcanoes of Popocatepetl and Iztaccihuatl, capped with perpetual snow, tower to a height of eight thousand feet or more above the Mexican plateau, as shown in Fig. 1.

The floors of the plateaus are substantially base levels of erosion—that is to say, the more ancient land surfaces were in olden days ground down by the action of the rains and rills to such low elevations above the sea that the streams could not further deepen their channels, whereupon the mountains were worn down into rolling plains. The hills and the mountains traversing the table-lands are often only the remnants of higher plains which have, so far, escaped destruction. Thus these elevated plateaus themselves demonstrate their subsequent great elevation above the sea.

In proceeding from Mexico into Central America, the high plateaus are not only necessarily of smaller extent, but they are more broken, and on the Isthmus of Panama they are almost replaced by mountain ridges rising from one to three thousand feet, except along a few lower passes.

* Appletons' Popular Science Monthly, 1898, vol. liii, pp. 10–30.

Interruptions of the Plateaus corresponding to the Antillean Basins.—In the paper upon The West Indian Bridge between North and South America it was pointed out that the Antillean seas formed three distinct basins—the Gulf of Mexico, the Sea of Honduras (between Cuba, Haiti, and Jamaica), and the Caribbean Sea, although the two latter are united at their surface under the name of the Caribbean Sea. In the investigations of the river valleys, now drowned beneath the West Indian waters, it was found that they were traceable to the floors of the three basins just mentioned. Accordingly, the hypothesis that these three basins were formerly drained into the Pacific Ocean called for corresponding depressions

FIG. 1.—VIEW OF THE MEXICAN PLATEAU FROM NEAR PUEBLA, showing the plains out of which rise isolated *cerros*, with the volcanic cones of Popocatepetl and Iztaccihuatl in the background.

across Central America and Mexico; and only such are found to occur (as shown in map, Fig. 2), although the continental barriers are now raised to considerable heights above the level of the sea. Thus the Mexican plateau rapidly narrows to a breadth of only twenty-five miles in the Tehuantepec Isthmus, where for a distance of sixty or eighty miles it is reduced so that the higher points do not exceed four thousand feet, and for a distance of perhaps over twenty-five miles the ridges do not reach an altitude of more than two thousand feet, with a repetition of base levels of erosion only nine hundred or a thousand feet in altitude among them. Indeed, these lower divides are further reduced at seven or eight passes which are only about eight hundred feet above the sea. Beyond these low depressions there are higher passes in the isthmus having an altitude of about twenty-seven hundred feet with accompanying plains. The Tehuantepec depression through the Mexican plateau

corresponds in position to an extension of the basin of the Gulf of Mexico, toward which, from the Pacific side, there is a similar indentation of the continental mass as shown on map, Fig. 2. The Honduras basin, indenting the Central American plateau, has a corresponding depression across it at an altitude of about twenty-seven hundred feet. The Caribbean Sea proper has a more uniform

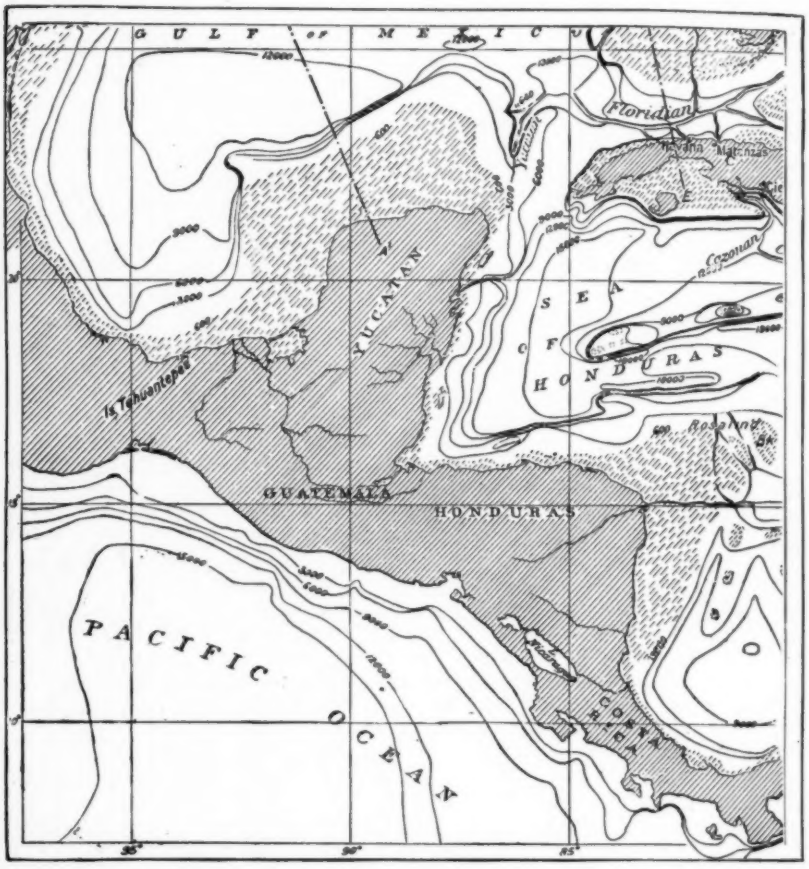


FIG. 2.—MAP OF CENTRAL AMERICA, showing the indentations corresponding to the Mexican, Honduras, and Caribbean basins. (Soundings in feet.)

breadth than the other basins, and in like manner the American barrier, which is here narrower than farther north, is dissected in several places, as might be supposed. These depressions make it appear that the Caribbean basin was connected by several channels across the continent with the Pacific Ocean. The Nicaragua depression is the most northern. The elevation of the valley east of Lake Nicaragua is about three hundred and fifty feet above the sea, although the San Juan has further dissected it so as to reduce its

channel to one hundred and three feet above tide. Between Lake Nicaragua and the Pacific the divide is reduced to two hundred and thirty feet, but a subsidence of the land to three hundred feet or so would connect the lake basin with the Pacific Ocean by eight or ten straits between as many islands.

While most of the Isthmus of Panama is traversed by mountain ridges from one thousand to three thousand feet high, these are dissected so that five of the deeper depressions are reduced to an altitude of from five hundred and fifty-three to eleven hundred and forty-two feet, while the Chagres River Pass, along which the railway is built, has a natural altitude of two hundred and ninety-nine feet, although the artificial cut reduces it to two hundred and fifty-four feet.

Besides the Nicaraguan and Panaman depressions across Central America, the valley of the Atrato and San Juan (to Buenaventura) forms a third and equally interesting depression between the Caribbean and Pacific basins. This valley is about three hundred miles long (direct course) and crosses Colombia between the Coast Range and the great Cordillera. The Atrato Valley is from forty to sixty miles wide, and for long distances above its mouth (Gulf of Darien) it is forty feet deep. At two hundred miles from its mouth the river is only forty-seven feet above the sea. Above this point, the tributary Rio Quito is still navigable for steamers to a distance of two hundred and seventy-three miles from the Gulf of Darien, and for eight miles farther canoes freely ascend the stream Santa Monica. Between this point and the navigable waters of the San Juan, only three miles distant, upon the other side of the divide, the elevation is so low that during high water canoes can even pass from the branches of one river to those of the other. Here the divide is reduced to about a hundred and fifty feet above the sea. The whole valley of the Atrato suggests a comparatively recent connection between the Caribbean Sea and Pacific Ocean. Across the Coast Range, separating the Atrato Valley from the Pacific, there are several passes at an elevation of only one thousand feet or less.

The Atlantic and Pacific Coastal Plains.—From the seashore, the coastal plains, on the Atlantic side of the continental plateau, slowly rise until they abut against the edges of the table-lands. These plains may have a width of only a few miles, or they may extend for a distance of considerably more than a hundred miles from the Gulf of Mexico. Back of Vera Cruz the coastal plains have a breadth of more than fifty miles and reach an elevation of seventeen hundred feet, while in the Tehuantepec Isthmus they extend for a distance of eighty miles from the sea and deeply indent the plateau region (see map, Fig. 7, page 588). Similar coastal plains form the eastern border of Central America, extending sixty-five

miles into Honduras and a hundred miles into Nicaragua; but at Panama they are reduced to a width of five or eight miles. The Pacific coastal plains of Panama are wider than those on the Caribbean side; but, generally speaking, the plains upon the western side of the table-lands are much narrower than those upon the Atlantic side. In Nicaragua they are reduced to eighteen miles in width, and even at Tehuantepec, where they set in from the Pacific Ocean and indent the plateau region, their breadth is only twenty-five miles (see map, Fig. 7, page 588). The coastal plains represent the lands which have been most recently elevated above the sea. When they were covered by the oceanic waters the Isthmus of Tehuantepec was only twenty-five miles across, and still less where penetrated by dissecting arms of the sea. The Panama Isthmus was reduced to five miles across.

CHARACTERISTICS AND TERRACES OF THE VALLEYS DESCENDING FROM THE HIGH PLATEAUS.—The plains, having no barriers to obstruct their drainage, and terminating at the margins of the high plateaus, indicate former base levels of erosion, and their great altitude shows the extent to which they have been elevated above

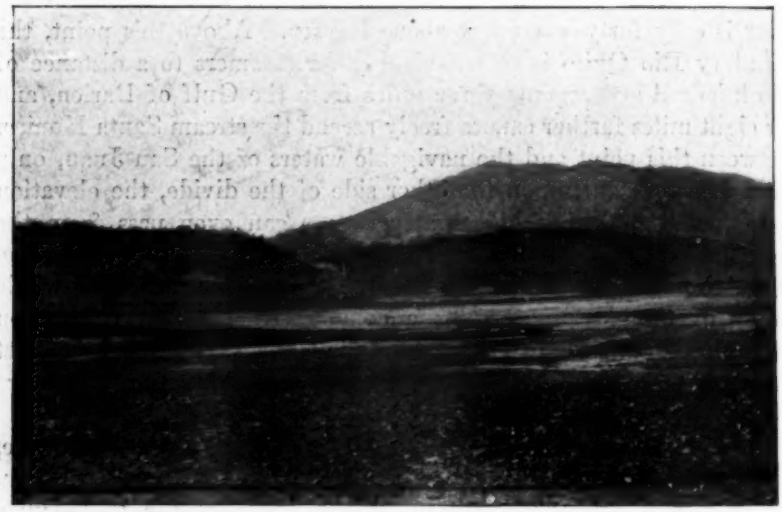


FIG. 3.—THE BASE LEVEL OR ELEVATED FLOOR OF THE SALAZAR SUMMIT OF THE INTERNATIONAL RAILWAY.

the sea. Their final surfaces may have been due in part to shallow accumulations of lake deposits leveling up the slight undulations of the old base-level surfaces, or these irregularities have at times been smoothed over by wind deposits. These superficial accumulations do not modify the general inference that the floors of the great table-lands were the effects of atmospheric agents, acting

throughout a long period, in wearing them down to near sea level. The remains of such elevated plains were observed at an altitude of even ten thousand six hundred and thirty-six feet above the sea, as shown in Fig. 3. This represents a level plain bounded by mountain ridges about a mile apart. It is the summit of a divide, also about

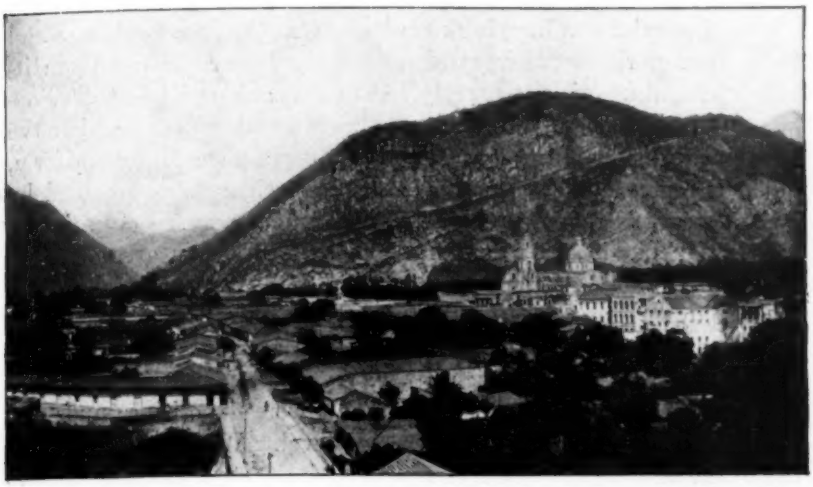


FIG. 4.—THE VALLEY AT THE CITY OF ORIZABA, showing broad terrace plains bounded by sculptured mountain scenery.

a mile long. Both ends of the floor of this mountain-bounded depression are open, and terminate in abrupt steps of three hundred feet or more to the next lower and very much greater plains. The margins of this flat summit are indented by short ravines of recent date (the character of which is illustrated in Fig. 6, page 585), that have not yet had time to be extended backward into the summit plain and to dissect it into sharp ridges and deep ravines.

Equally abrupt are the margins of the plateau back of Vera Cruz (at about eight thousand feet above the sea), which may be taken as a type of the high base levels of Mexico. The borders of the high plateaus are dissected by deep valleys, which, when compared with the extent of the elevated plains, are remarkably short—often only a few miles long. The distance between Esperanza, upon the edge of the plateau (at an altitude of eight thousand and forty-two feet), and Atoyac (at fifteen hundred and twelve feet), near where the valley opens on the coastal plain, is only about forty miles in a direct course. The valley is from one to two or more miles in width, and is of course very deep. Upon its broad terrace plains the city of Orizaba and other large towns are situated, as shown in Fig. 4. Compared with the age of this large, deep valley, which is sufficiently old to have what were once the precipitous bounding walls

of a great cañon now rounded off into sloping mountains, the Mexican plateau, of hundreds of miles in extent (at an altitude of eight thousand feet more or less), which is dissected for a distance of only forty miles, is of great age. Here again the elevation of the table-land has been too recent to have been converted into rugged mountain ridges and deep valleys.

This Mexican valley back of Vera Cruz, whose grandeur and beauty are perhaps unsurpassed, and depend more or less upon its youthful features, is not exactly modern, for since its first development it became partly refilled with muds and gravels, which the streams are again removing. The slope of its floor is not uniform, but it is represented by great series of gradation plains bounded by abrupt steps, as shown in Fig. 5. These steps may be only five or ten feet in height, or several may coalesce into one great terrace. Three of the greater steps are perhaps five hundred feet above the floor below. The valley heads abruptly in an amphitheater which forms a step a thousand feet in height. These gradation plains, thus abruptly separated from each other, represent pauses in the elevations of the table-land, when the streams were depositing muds and gravels and forming low flats near sea level. With the subsequent rise of the land these became terraces which the streams soon began to dissect and form in them deep channels and cañons. The newness of these cañons and smaller channels is shown by the fact that they are seldom more than a quarter of a mile long, although varying in depth from several hundred to a few feet; and the loose gravel floors, except at the margins of the terraces, have not even been

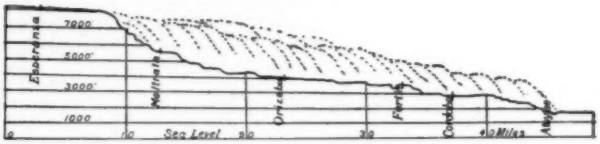


FIG. 5.—SECTION OF THE VALLEY BETWEEN ESPERANZA AND ATOYAC, showing its gradient to be composed of numerous abrupt steps.

removed. These short cañons are characterized by beautiful waterfalls, as illustrated in Fig. 6.

The characteristics of the slopes and terraces of the valley descending from the high plateaus have been described because they illustrate evidence of great elevation, which has occurred in Mexico and Central America in recent geological times, with the later movements belonging to almost modern days.

In place of an elevation of from six thousand to ten thousand feet obtaining, as shown in many parts of the Mexican table-lands, the uplift in the Tehuantepec Isthmus closing the outlet of the Mexican basin into the Pacific Ocean apparently amounts to less than

a thousand feet; and indeed an elevation of seven hundred and seventy-six feet has been enough to withdraw the waters from the last canal across the continental barrier. But of this again.

The same story of the rise of the land and the separation of the seas is repeated in Central America—in Honduras, in Nicaragua, and in Colombia, whether at Panama or not, as appears from the observations of Mr. J. Crawford, Dr. W. M. Gabb, Dr. G. A. Maack, and especially of Mr. F. C. Nicholas, in the Atrato Valley. But the phenomena accompanying the great changes of level have not been so fully studied farther south as in Mexico.

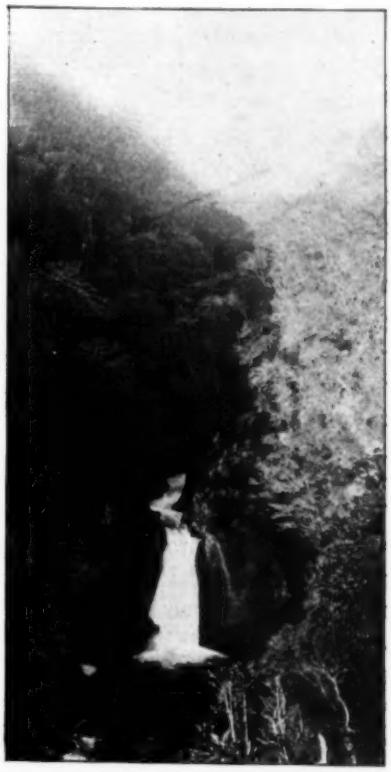


FIG. 6. — FALLS BELOW ATOYAC, passing through a short, deep cañon, descending from the terrace plain faintly shown in the high background of the picture.

THE MANNER IN WHICH THE ELEVATION OF THE PLATEAU OCCURRED. — There are various great terrestrial movements known to geologists. Extensive continental areas are gently rising and others are sinking. These oscillations, so far as time is concerned, appear slow—as, for instance, the sinking of the New Jersey coast at the supposed rate of a foot in half a century, or of the New Orleans district, of a foot in twenty years; while the rising of the northern part of the continent, as between the Adirondack Mountains of New York and the St. Lawrence River, is at the rate of a foot in twenty or twenty-five years. Within a generation the changes of level in the physical geography of a special district are no more apparent to the ordinary inhabitant than the shallowing or deepening of small channels which interfere with or favor the passage of canoes or small boats, or the gentle backing of waters which make swampy grounds or the reverse. Even with their effects, accumulated for centuries, the changes do not often affect the course of the drainage or obstruct it. By this gentle continental movement the mountains are not formed, nor are ridges squeezed up into existence, although they often give rise to high land. Since the beginning of the Glacial

period, the accumulations of such movements have raised the same superficial formations of the coastal plains of America to an altitude of one hundred feet near Cape Hatteras, to eight hundred feet farther south, to fifteen hundred feet in the neighboring mountain region, to only three hundred or four hundred feet in the Mississippi Valley; while the same coastal plain in Mexico has been elevated to seventeen hundred feet. Farther south, in the Tehuantepec Isthmus, the corresponding change of level has not been more than eight hundred feet. These movements do not bend, crumple, or break the strata, or appreciably affect their horizontality. The amount of elevation just mentioned was sufficient to cause the final separation of the Mexican Gulf and the Pacific Ocean, but inadequate to account for the high plateaus.

Another class of terrestrial movements gives rise to mountain folds, thrusts, and faults, with a general dislocation and disturbance of all the formations. Just how much of a plateau was elevated by these forces is not apparent, for the surface base levels of erosion still retain their older courses of drainage. Consequently, one is led to suspect that the great escarpments are not entirely due to denudation, but that a third class of earth movements has obtained, lifting the plateaus abruptly to a considerable proportion of their height (six thousand feet, more or less) above the inner margin of the coastal plain, without greater deformation of their surface than that of the coastal plains themselves. This third movement seems to be a sort of squeezing up of great segments of the earth's crust, without tilting its surface by more than a few feet per mile; consequently, it implies a great dislocation and slip or fault along the margin of the table-land, since modified upon the surface by the atmospheric denudation. The analysis of these complex movements is far from complete, and, although we do not fully understand them, this ignorance of causes does not affect the evidence of the very recent elevation of the plateaus.

The Periods of Great Elevation.—The old geological formations of the plateaus are mostly buried beneath secondary accumulations; so that the present physical surface features are largely due to the atmospheric agents which have been at work since about the end of the Cretaceous period, as out of the formations of that date a large portion of the base levels of erosion have been molded. These great base levels required a long time for their development, which was provided for during the greater portion of the subsequent Tertiary period, when the present table-lands were mostly low continental plains interrupted by mountain ridges. In the meanwhile, the present coastal plains (now rising to seventeen hundred feet) were submerged and were receiving the older Tertiary accumulations

under the waters of the Gulf of Mexico. The Tehuantepec Isthmus (Fig. 7, page 588) was throughout the late Miocene and Pliocene periods covered by deep water, as seen by the occurrence of such fossils in the horizontal formations accumulated there, thus showing that there was a strait or water way across the continental barrier, subsequent to the great physical dislocations and changes of level occurring in the earlier Miocene period.

Without considering the minor oscillations of land and sea which raised the coastal plains during the later Tertiary period, it has been found that these plains were covered with water about its close (end of the Pliocene period). Until about this time the present table-lands do not appear to have been elevated. The lavas and other similar rocks derived from Orizaba and sister volcanoes upon the present edge of the great plateau date back only to about the close of the Pliocene period, and appear to have originated with the elevation of the region. The excavation of the great valleys, such as that described back of Vera Cruz, has been subsequent to the commencement of this volcanic epoch, and consequently the elevation of the plateau can not date back prior to about the commencement of the Pleistocene period (or the beginning of the ice age). After the time of the first great elevation with the formation of the original valley, the region was more or less depressed, when gravels and muds were accumulated upon its floor during midglacial epochs; since when the table-lands have attained their great elevation, with the formation of the terrace steps already described, so recently that the streams have not yet removed these loose deposits, and are only in the early stages of making new cañons.

From all that has now been ascertained, it appears that the great elevation of Mexico and Central America was chiefly effected by the Pleistocene changes of level; and from the magnitude of continental movements in both directions and the excavation of large valleys out of very hard rocks, it would seem that this period must have been one of long duration.

THE GEOLOGICAL WATER WAY ACROSS THE TEHUANTEPEC ISTHMUS.—As has already been mentioned, the great continental table-lands are here broken down for a distance of perhaps eighty miles, with the resulting lower ranges for a length of twenty-five miles penetrated by numerous lower channel ways. The reduction of the width of the plateau is shown in map, Fig. 7, where the shaded portion represents the coastal plains setting into the highland mass, which is only about twenty-five miles across. While this district was a strait during the Pliocene period, in which deep water organisms were living, the existing gap in the Cordilleras was being widened so as in part to complete the great interruption in the American plateau.

Although the geological water way was open during this period (more recent than has generally been suggested), it was afterward closed for a time, and the subsequent connection between the Gulf of Mexico and the Pacific is the most interesting to us, as reaching down almost to the historic period. The date of the older strait was prior to the Lafayette epoch (about the close of the Pliocene or commencement of the Pleistocene period), while that of the later one obtained well on in the Pleistocene period. The separation of the seas was in part effected by gentle warpings of the district, but the low Cordilleras seem to have been further squeezed upward by a movement referred to on a preceding page. Out of the floor of the present divide, the rocky islands of the recent strait became prominent knobs (such as one shown in Fig. 9). The newly formed isthmus was only a mile or two across. Its once nearly level floor, composed of soft, earthy sandstone, has since been rounded into a succession of hummock-like hills by the subsequent action of rains and rills. This feature is shown in Figs. 8 and 9. For a time the narrow isthmus was penetrated by a geological canal, one hundred and fifty feet deep and less than a quarter of a mile wide, the features of which

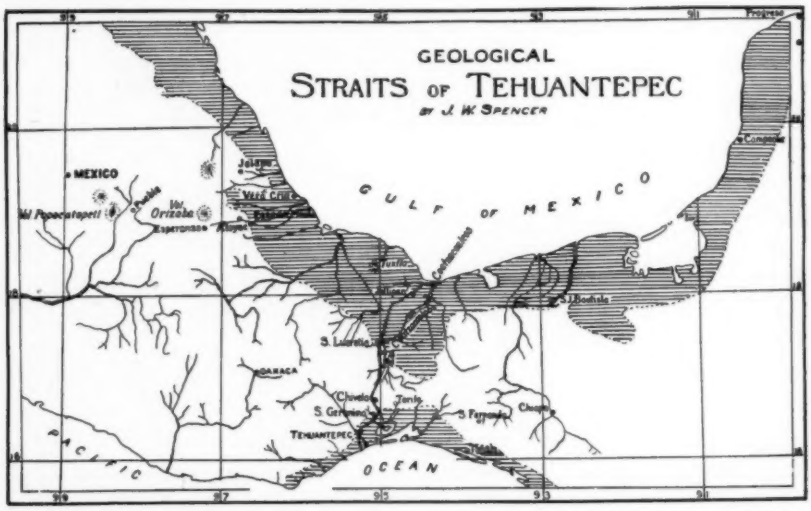


FIG. 7.—MAP OF THE ISTHMUS OF TEHUANTEPEC. The unshaded portion represents the high plateau region as indented by the coastal plains (shaded).

are now perfectly preserved in the channel, about a mile long, which dissects the hummocky divide of the Tehuantepec Isthmus. The northern end of this canal is shown in Fig. 9. The floor of this passageway is still covered with water-worn gravel, which was deposited by the former currents. Connected with this late channel and at the same level, gravel terraces mark the shores of the Gulf

of Mexico when its waters were last connected with the Pacific Ocean, although the barrier has now been raised to seven hundred and seventy-six feet above the sea. Since the elevation of the land, which finally separated the Gulf of Mexico from the Pacific in post-

FIG. 8.—THE DIVIDE OF THE ISTHMUS OF TEHUANTEPEC AT CHIVELA, eroded into hummocks, with a gravel plain in front (northern side).

Glacial times, the excavation by the streams has produced only narrow cañons, at most a mile or so in length and three hundred or four hundred feet in depth, while the gravel floors and terraces remain almost intact. Indeed, the final elevation seems to have been even later than the birth of Niagara Falls. Thus the separation of the Antillean and Pacific waters is found to have been much later than has hitherto been supposed. So recent is the geological canal of Tehuantepec, that it would be reasonable to suspect its existence even since the advent of man upon the earth, although the proof of his occupancy of the district and his utilization of the passage has not been found. Had the appearance of the barriers been retarded for only a little while longer (geologically speaking), the engineering difficulties of constructing interoceanic canals would have been avoided.

A sister canal to that described occurs a few miles toward the east, and probably similar narrow channels are found in the other half-dozen low passes of the region which have an altitude of about eight hundred feet.

THE ATRATO AND OTHER WATER WAYS.—The low country of the Atrato-San Juan Valley of Colombia has been mentioned as an important depression in the barrier between the Caribbean Sea and

Central America, and Dr. Maack and others have suggested a connection at some previous time. By Mr. F. C. Nicholas enough data have been gathered to make it appear that a geological strait and later a canal or canals obtained similar to that of Tehuantepec. The barrier between the low navigable waters on each side of the divide is only eleven miles across, and of this distance, the valley is so low that except for three miles of its course it is navigable for canoes at all times. During floods even the remaining three miles can be crossed in small boats. This passage is only about a hundred and fifty feet above the sea, but it is a narrow canal a hundred

FIG. 9.—THE DIVIDE OF THE ISTHMUS OF TEHUANTEPEC (view on larger scale than in Fig. 8), showing the northern end of the geological canal dissecting the divide to a depth of about one hundred and fifty feet. Knob to the left represents the end of a ridge rising out of the old geological strait.

feet or more below the summit of the dividing ridge. The barrier in part appears to have been produced by the delta deposits brought down from the lateral mountains by the streams at a time when the valley was occupied by the waters of a great strait from twenty to forty miles wide, connecting the Caribbean Sea with the Pacific Ocean. Some of these gravels contain large quantities of gold. The gold-bearing gravels and other alluvial deposits which rise upon the hillsides and occur on the divide seem to mark the different changes of level corresponding to those in the Tehuantepec Isthmus.

Besides this Atrato Strait, connecting the Caribbean Sea with the Pacific Ocean, there was another connection by way of Nicaragua, as suggested by Mr. Crawford's studies, but the latest geological canals across this region have been obstructed by barriers rising to two hundred and thirty feet. The more open country of the Panama

district is about four hundred and sixty feet above the sea, but it is dissected by valleys such as that followed by the railway, whose natural divide is two hundred and ninety-nine feet. It is only reasonable to suspect that here may have been a former strait or canal, but so far the terraces and gravel floors similar to those of the Tehuantepec divide have not been described, as this is a feature of only recent scientific inquiry. The interoceanic connections referred to by Dr. Maack belong to the older Tertiary period, preceding the sculpturing of the physical features of the region, which were long anterior to the water ways here described.

Biological Evidence of Interoceanic Connections.—The fishes, shells, sea urchins, and other organisms of the West Indian basins belong to modern types, which to a large extent seem to have migrated from the Atlantic Ocean. Their recent appearance suggests great changes in the physical history of the West Indian seas, which are only explicable on the theory of the Antillean bridge, as set forth in the May number of this journal, and extended in the present paper. For example, the West Indian region was a high continental mass with extensive plains where the sea basins now occur, draining into the Pacific Ocean across the central part of America. With the subsequent subsidence in the mid-Pleistocene epoch the Antillean basins became seas, into which the modern Atlantic forms of life gained access. The deep-sea fishes have absolutely no relationship with those living in the Pacific Ocean, thus showing that the American barrier obtained sufficient height for their exclusion; but the littoral or shallow-water fishes and shells of the Pacific Ocean, to a notable degree, are found in the West Indian waters. The term deep-sea fauna here used applies to those forms living at greater depths than from three hundred to five hundred feet, according to circumstances. Thus it would appear that there were shallow water connections with the Pacific Ocean in or since the mid-Pleistocene epoch, such as have been shown from the study of the physical features. But these water ways were either too small or of too short duration for the general admission and commingling of Pacific and Atlantic types. The modern characteristics of the deep-sea fishes of the West Indian basins suggest that the older forms of Antillean life had been expelled from the region, so as not to permit of the development of their successors, as should have occurred if the continental area, now drowned, had not been generally drained. The modern *facies* of the marine West Indian life thus supports the physical evidence of a great Antillean continent or connection between North and South America just prior to the introduction of modern species. There is no inconsiderable degree of satisfaction to the student in finding that the biological phenomena support the

physical testimony of the recent great changes which have occurred in the Central American and West Indian regions.

ON THE CONFIRMATION OF THE WEST INDIAN CONTINENT BY CENTRAL AMERICAN PHENOMENA.—The Reconstruction of the Antillean Continent,* and The West Indian Bridge between North and South America,† have been largely based upon the testimony of the great river channels being traceable as drowned valleys of natural proportions across the submerged plateaus or margins of the land to the floors of the Gulf and Caribbean basins, which are characterized by large plains. This fundamental feature is supported by a great array of facts collected by the writer and described in the papers named. It was during the early part of the Pleistocene period that the West Indies were united into a high plateau and the floors of the sea basins were transformed into plains, to the margins of which the river valleys have been traced. The continuance of the river valleys to the floors of the sea basins is the result of their formation upon the surface of the land before the region was submerged beneath the oceanic waters. Satisfactory as was the evidence of the high continental elevation to the east, the Central American region now appears as a barrier against its former drainage to the Pacific, thus producing inclosed sea basins. On a smaller scale, there is a perfect analogy in the basin of Lake Ontario, which is only the valley of the St. Lawrence, mostly closed by warping of the earth's crust so as to raise up a barrier of several hundred feet in place of thousands of feet, as is the case in Central America. It was very significant that the depressions in the Mexican and Central American table-lands correspond only to the extensions of the West Indian basins, thus suggesting the location of their outlet. But the discovery of the recent general elevation of the American barrier to thousands of feet, and the preservation of the last water ways across the divide, are found to show that the barrier did not obtain at the time when the Antillean basins, according to the hypothesis, should have been drained into the Pacific. Thus the low altitude of Central America at the time of the high continental elevation to the east and the presence of the recent water ways to the Pacific Ocean, lately discovered, complete, in a manner, the story of the great oscillations of land and sea in the regions between North and South America.

Of the two miles or two miles and a half in height of the Central American barrier above the floor of the sea basins, probably half that amount has been produced by gentle warping of the earth's crust, amounting to only a few feet per mile, like that across the outlet

* Bulletin of the Geological Society of America, vol. vi, pp. 103–140, 1894.

† Appletons' Popular Science Monthly, vol. liii, pp. 10–30, 1898.

of Lake Ontario—so gently developed as not to produce bold features. On the other hand, portions of the barrier have been squeezed up by local movements, causing the plateaus, whether above or below the surface of the sea, to rise rather suddenly from the plains in front of them.

Thus the story of the West Indian bridge and the geological water ways across Central America * are only different chapters of the great changes of level of land and sea which have occurred in the most recent geological times, illustrating terrestrial movements now in progress, which have the power of completely altering the physical features of the earth, transposing tropical and arctic climates, and scattering or exterminating animal and plant life of continental regions.

CURIOSITIES OF AMERICAN COINAGE.†

By ALEXANDER E. OUTERBRIDGE, Jr.

IT is remarkable, in view of the universal desire of mankind to obtain money, that so few persons, comparatively, really know anything about the early history of money, or the social and industrial conditions which led, long ago, to the substitution of pieces of coined money for direct barter—in short, when, where, and how the art of coining and use of metallic money originated. These are interesting subjects for historical and archæological research, and they have a direct practical relation to the development of the modern science of money. Elsewhere I have gone over this classical ground, and I propose, on this occasion, to limit the field to be surveyed to that portion of the subject which relates particularly to the early history of American coinage and its modern developments. There are many curious and important facts relative to this coinage with which the people are either wholly or in part unacquainted.

My subject will be comprised under four heads—viz.: 1. The Functions of Money. 2. The Early Colonial Coinage. 3. The Coinage by Private Individuals or Companies. 4. The National Coinage.

* For further details, see Great Changes of Level in Mexico and the Interoceanic Connections. Bulletin of the Geological Society of America, vol. ix, pp. 13–34, 1897.

† An address delivered in the Museum of Science and Art, University of Pennsylvania, March 23, 1898. The illustrations of rare gold coins of the "private issues," accompanying this article, were made from the collection deposited in the museum of the university by Mr. R. C. H. Brock, of Philadelphia, and were furnished by the director to this magazine several weeks in advance of the publication of the address in a bulletin of the museum to be issued in the future, and containing many other communications of archæological interest.

THE FUNCTIONS OF MONEY.—In Money and the Mechanism of Exchange, Professor Jevons relates an amusing experience of a Parisian singer who made a professional tour of the world some years ago. In crossing the Pacific Ocean the steamship was unexpectedly

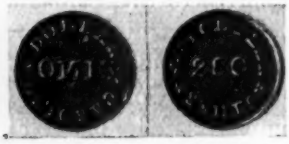
$2.50 gold piece. T. Reid. Georgia gold, 1830.

$1 gold piece. North Carolina gold; 30 grains. C. Bechtler.

compelled to call at the Society Islands, where she was detained for a day or two. A few foreigners who were there invited the singer to give a concert, agreeing that she should receive one third of the gross proceeds. The lady accepted the invitation, and the concert was well attended by the natives, who came from all parts of the islands. When the receipts were counted the lady found that her share consisted of several pigs, fowls, goats, and a large quantity of bananas, cocoanuts, and other tropical fruit. There was very little money in circulation on the islands, and, as mademoiselle could not consume any considerable portion of her share of the proceeds of the concert, it became necessary to feed the live stock with the fruit.

This story is told to illustrate a difficulty which arose in the earliest commercial transactions from the want of a common medium of exchange, which difficulty led to the invention (about 700 B. C.) of coined money as a "go-between" or substitute for direct barter.

At the first glance it might appear a simple matter for the butcher, the farmer, or the miller to make due exchange of commodities without the intervention of the go-between called money, but a little reflection will soon reveal at least three great difficulties:



$1 gold piece. Carolina gold; 28 grains. Bechtler.

$1 gold piece. Carolina gold; 21 carats, 27 grains. A. Bechtler.

First, that of finding two persons whose disposable goods mutually suit each other's wants; second, the impracticability of subdividing many articles—for example, a tailor can not cut up a coat into small portions without destroying its value; third, the complexities involved in equitably adjusting the relative values of various commodities. These and other difficulties led to the selection, quite early in

the history of civilization, of certain substances which, by common consent, were received by all persons in exchange for all commodities at certain rates by mutual agreement. A curious variety of materials have, at different times and in different countries, served this useful purpose, and it is evident that such substances would soon come to possess the two great functions of money, viz.:

$2.50 gold piece. Georgia gold; 22 carats, 64 grains. Bechtler.

1. A common medium of exchange.
2. A common measure of value.

In the most primitive age the skins of wild animals were usually selected, being both useful and portable. Even in the early part of this century the business of the Hudson Bay Trading Company was transacted with the North American Indians entirely on this basis; a gun, for example, was valued at "twenty beaver skins." In Massachusetts (and other colonies) prior to the Revolution specie was at times so scarce that laws were passed legalizing the payment of taxes in skins, cattle, and farm products.

It is said that in the mountainous districts of Kentucky skins are used even to this day as currency to a limited extent by the natives.

In Massachusetts a law was enacted, March 4, 1634, as follows: "It is likewise ordered that muskett bulletts, of a full boare, shall pass currantly for a farthing a-piece, provided that noe man be compelled to take above XII pence att a tyme in them."

Early Colonial Coinage.—The inconvenience experienced from the want of specie caused the colony of Massachusetts to establish a mint as long ago as the year 1652; this was exactly one hundred and forty years before the establishment of the National Mint in Philadelphia. The Massachusetts law provided for the coinage of "shillings," "6 pence," and "3 pence," all of sterling silver—that is, 925 parts of pure silver and 75 parts of copper; the law stipulated that the coins were "to be reduced in weight 2 pence in the shilling less than the English coin." A curious mistake occurred in the calculation whereby these shillings were made 5½ grains too light, but they served a good purpose notwithstanding. The device upon the coins is a "pine tree," and the Massachusetts pine-tree shillings are now so rare that they are only to be found in cabinets of coins.

$5 gold piece. Georgia gold; 22 carats, 128 grains. C. Bechtler.

The British Government opposed the establishment of this mint,

as it did in fact all manufacturing industries of every kind in the colonies, but the mint continued in active operation for over thirty years, and Maryland soon followed Massachusetts' example. These were the only silver coins issued before the Revolution, but several other American colonies issued copper coins. After the Revolution silver was coined by the different States, and even by private individuals, and very soon after peace was established Congress began agitating the subject of a national coinage. Robert Morris, the financier, was directed to present a scheme of coins and currency. His first report (prepared by the assistant financier) was presented in 1782, and it proposed a decimal system, which has been adopted, but all the other features were discarded, chiefly on account of the diminutiveness of the proposed "unit," which was only one tenth of a penny. Jefferson said in the discussion, "A horse or bullock of $80 value would require a notation of six figures, to wit: 115.200 units." A few years later Jefferson himself presented a report proposing the Spanish milled dollar as a suitable unit, as this coin was very familiar to the people and of a convenient size; these proceedings were under the "Confederation," and one of the articles of the original compact permitted coinage "by the respective States." Vermont, Connecticut, Massachusetts, and other States issued coins under this arrangement for a few years, until the Constitution in 1787 vested the right of coinage solely in the General Government.

$5 gold piece. Carolina gold; 20 carats, 140 grains. C. Bechtler, August 1, 1834.

$5 gold piece. Carolina gold; 21 carats, 134 grains. A. Bechtler.

For some reason, not known, the code of laws for establishing the National Mint was not formulated until five years later.

The act of April 2, 1792, provided for the establishment of a mint, and for the coining of ten, five, and two-and-a-half dollar gold pieces; also one dollar, one-half, one-quarter, one-tenth of a dollar in silver; one cent and half-cent in copper.

Pattern coins were struck at the Philadelphia Mint in 1792;* some of these bore the head of Washington on one side, but he dis-

* A rare pattern piece of 1792 was in the form of an annular ring of copper having a silver plug in the center. A large copper penny of 1792, with head of Liberty and an eagle resting on the globe, brought at public sale, in New York in 1890, the sum of two hundred

approved of the device, and suggested the substitution of the head of Liberty. Since that time no American coin has ever displayed the head of any individual.

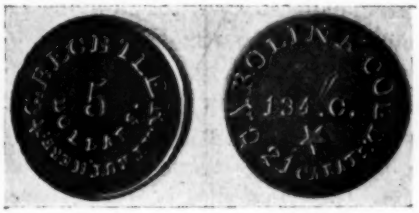
COINAGE BY PRIVATE INDIVIDUALS AND COMPANIES.—An exceedingly interesting, curious, and indeed inexplicable feature of the early history of coinage of money in America, regarding which there is but little accurate information available at the present day, is the issuing, on a large scale, of gold, silver, and copper coins (also "tokens") by private individuals and by trading companies. It will surprise many, no doubt, to learn the extent to which this practice was carried, and that it was permitted to exist until a comparatively recent period, notwithstanding the express prohibition in the Constitution of all such acts.

$5 gold piece. Carolina gold; 20 carats, 140 grains. C. Bechtler, August 1, 1834.

In a report made to Congress by the director of the Mint (Dr. Patterson) in 1840, these words may be found:

"Coinage of gold and silver, though withheld from the State, is freely permitted by individuals."

In 1850 the assayers of the Mint (Eckfeldt and Du Bois) reported: "There are several classes of gold coins which are struck within the national boundaries, but are not of the United States; these are Bechtler's coins of North Carolina and the California coins."



$5 gold piece. Carolina gold; 21 carats, 134 grains. C. Bechtler.

$5 gold piece. California gold. N. G. & N., 1849.

In 1851 the assayers reported that twenty-seven different kinds of gold coins, issued from fifteen private mints, had been received and assayed at the United States Mint in Philadelphia.

The earliest private coinage intended for use in the colonies of America (except the Bermuda "hog" coins) is known to numismatists under the general name "Rosa Americana," and the story con-

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and ten dollars. Silver "dismes" and "half-dismes," having a bust of Martha Washington, were struck in 1792, and are now highly valued.

nected therewith is most remarkable. In the year 1722, Mr. Wood, an iron founder of Wolverhampton, England, claimed to have discovered an alloy suitable for coins, consisting of copper, zinc, and a small proportion of silver. Through the influence of a favorite of

$5 gold piece. Native gold; 130 grains. Oregon Exchange Company, 1849.

$5 gold piece. Utah (Holiness to the Lord), 1850.

George I, known as the "Duchess of Kendall," a patent was issued by the king, dated July 12, 1722, together with a "royal licence," which was to continue for fourteen years, for coining "tokens" for Ireland and the colonies of North America to a large extent—viz., "three hundred tons"; the amount of the Irish coin was limited to £105,000, a great sum at that day.

A small royalty of £100 a year was to be paid into the king's exchequer and a salary of £200 to an officer of the Crown, called the "comptroller." Sir Isaac Newton, then the director of the Royal Mint, was chosen for this office, and he served for a short time, when he nominated a nephew, who succeeded him.

Thousands of Wood's base metal coins were struck for use in Ireland, and the issue would probably have been accepted by the people without question, had it not been that Dean Swift, then living in seclusion, saw in this scheme an opportunity to attack the English Government, and by his Drapier's Letters, his poems, and other writings, all anonymously published, in which he mercilessly lampooned the scheme and all those who were in any way connected with it, he aroused a storm of fury that is said to have been "indescribable." A writer of the day said: "All parties, Catholics and Protestants, Whigs, Tories, Orangemen, and Rapparees, were equally frantic. Merchants publicly announced that they would not accept the coin; the very hawkers and link-boys refused it, declaring it would buy neither ale, tobacco, nor brandy. Wood's effigy was dragged through the streets of Dublin and burned. . . .

$20 gold piece. Utah (Holiness to the Lord), 1849.

The Privy Council offered a reward of £300 for the discovery of the author of the Drapier's Letters."

The king then ordered the proposed issue to be reduced to £40,000, but this did not assuage the excitement in the least, and it finally became necessary, in order to restore peace, to buy back the royal license from Mr. Wood, by the payment to him of a pension of £3,000 a year for fourteen years.

This failure did not, apparently, kill the project for coining money for the American colonies, and the many pieces actually struck for that purpose are creditable specimens of the art at that period. On the obverse appears the head of the king and on the reverse a full-blown rose, with the legend "Rosa Americana," and the date "1722." On the later issues the head of George II appears, and the date 1733.

There is preserved in the Massachusetts archives a letter of instructions, dated October 29, 1725, from the Duke of New Castle to the Governor of Massachusetts, saying:

"Sir, His Majesty having been pleased to graunt to Mr. Wood his letters patent for the coining of two pence and half pence pieces of the value of money of Great Britain for His Majesty's dominions in America, which said coin is to receive such additional value as shall be reasonable and agreeable according to the customary allowance of exchange in the several parts of His Majesty's dominions, as you will see more at large by the patent which will be laid before you by the person that delivers this letter to you, I am to signify to you His Majesty's pleasure that in pursuance of a clause in said patent by which all His Majesty's officers are to be aiding and assisting Mr. Wood in the due execution of what is therein directed and in the legal exercise of the several powers and enjoyment of the privileges and advantages thereby graunted to him, you are to give him all due encouragement and assistance, and that you and all such other of His Majesty's officers there, whom it may concern, do readily perform all legal acts that may be requisite for that purpose. This I am particularly to recommend to your care, and to desire your protection to Mr. Wood and to those whom he shall employ to transact this affair in the Provinces under your government. I am Sir, Yr Most Humble Servant,

"NEW CASTLE."

If we may rely upon the statement of an English writer of the day, Mr. Wood's coin did not meet with a very cordial reception in America, for the pamphlet says:

"Wood obtained a patent for coining small money for the English plantations in America, in which he had the conscience to make thirteen shillings out of one pound of brass; this money they rejected in a manner not so decent as that of Ireland."

In the year 1830 Mr. Templeton Reid, of Georgia, established a private mint, at which he coined $10, $5, and $2.50 gold pieces;

these circulated freely through the South, and they were brought to the United States Mint in Philadelphia for deposit and remelting in quantities. The assayer reported in 1842 that the $10 gold pieces of T. Reid weighed 248 grains, contained 942 parts of pure gold in 1,000 parts of metal, and the intrinsic value slightly exceeded the nominal value, being worth $10.06. These coins are now quite rare.

In 1831 Christopher Bechtler, of Rutherfordton, N. C., followed Mr. Reid's example on a larger scale, and in a few years he had issued several million dollars' worth of gold coins of denominations of $10, $5, $2.50, and $1.*

In 1842 the Mint assayers stated that "coining is still carried on by Bechtler, although there is a branch United States Mint less than eighty miles distant." This was located at Charlotte, N. C.

In 1851 the assayers reported that "several of the private issues of gold coins from California are close imitations of the national coin; some assay nearly up to the nominal value, but many fall be-

$5 gold piece. California gold. S. M. V., 1850.

$5 gold piece. Pike's Peak gold. Clark & Co., Denver, 1860.

low." A $10 piece of the Pacific Company only yielded $7.86 in gold. A lot of different denominations aggregating $562.50, nominal value, yielded at the Mint in Philadelphia $479.20.

One interesting gold coin, a $50 piece (some were octagonal), issued by Augustus Humbert, United States assayer at San Francisco, yielded the full nominal value. All of these private issues have now been stopped, and strict laws have been passed punishing any attempt to imitate the coins of the nation; even the toy money formerly made for children of gilded paper has been prohibited by the Government authorities.

THE NATIONAL COINAGE.—The Mint was established in Philadelphia in 1792 and in its first year issued pattern pieces only; coining of copper cents and half cents commenced regularly in 1793, and stamping of the other denominations of money, as already named, in 1794 and 1795.

Many persons believe that the so-called "dollar of the daddies," weighing 412½ grains (nine tenths fine), having a ratio to gold of "16

* In 1840 Mr. Bechtler stated that the amount of his coinage to date was $2,241,840.

to 1 " in value when first coined, was the original dollar of the Constitution. This is, however, erroneous. The 412½-grain silver dollar was not authorized until forty-five years later. The original silver dollar weighed 416 grains, and the ratio of silver to gold was 15 to 1, not 16 to 1.

Several modifications in weight and fineness of both gold and silver coins were made during the first few years, prior to the act of January 18, 1837, which greatly simplified the coinage by adopting the French decimal system, including a uniform "fineness," or proportion of 9 parts of gold to 1 part of copper for the gold coins, and the same proportion of silver and copper for the silver coins; the weights of the gold and silver coins were, at the same time, readjusted so as to make the ratio "16 to 1" between silver and gold.*

$5 gold piece. Pike's Peak gold. Clark, Gruber & Co., Denver, 1861.

The total issue of silver dollars coined under the acts of 1792 and 1837 until 1873, when the coinage was dropped, amounted to $8,031,238. When the Bland act was passed, in 1878, the silver in the silver dollar weighing 412½ grains was worth 89.1 cents; to-day the silver in the same dollar is worth about 42.5 cents. In the first four months after the Bland bill was passed 8,573,500 Bland dollars were coined, or more than the entire issue of the old silver dollars in eighty years. In the same year also the Mint coined 11,378,610 "trade dollars," which weighed 7½ grains more than the Bland dollars, but were not "legal tenders," † and, though issued by the United States Mint, were refused by the United States Government in payment for postage stamps, taxes, or for other dues, while the Bland dollar, of lesser intrinsic value, was a legal tender, and good for payment of all debts. The total issue of trade dollars between 1873 and 1879 was 35,965,924,

$2.50 gold piece. Clark, Gruber & Co., Denver, 1861.

* The original silver dollar, authorized under the act of April 2, 1792, contained 892.4 parts of pure silver in 1,000 parts of metal and weighed 416 grains. The act of January 18, 1837, changed the proportion of silver to 900 parts in 1,000 and the weight to 412½ grains; the amount of pure silver thus remained unchanged.

† The act of February 12, 1873, made the trade dollar a "legal tender in sums not exceeding five dollars; this legal-tender quality was withdrawn by the joint resolution approved July 22, 1876, and the coinage was limited to such amount as the Secretary of the Treasury should consider sufficient to meet the export demands."—*United States Treasury Department, Circular No. 143.*

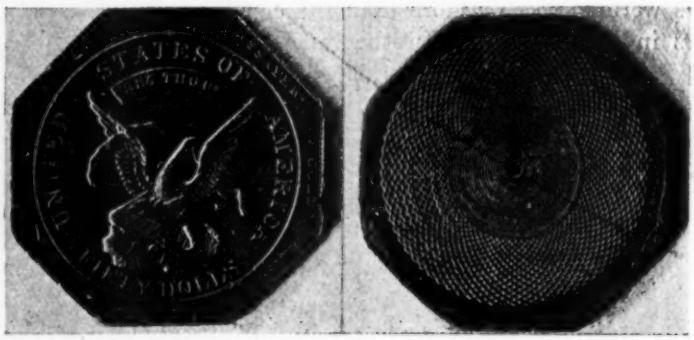
and the total issue of Bland dollars, from 1878 to the close of the fiscal year 1897, was 451,993,742.

The following table shows the total coinage value of all denominations of silver coin from the establishment of the United States Mint in 1792 to the end of the last fiscal year, June 30, 1897:

Dollars	1792 to February 12, 1873	$8,031,238 00
	1878 to June 30, 1897	451,993,742 00
Trade dollars		35,965,924 00
Half dollars		134,033,195 00
Columbian half dollars		2,501,052 50
Quarter dollars		52,395,052 00
Columbian quarter dollars		10,005 75
Twenty-cent pieces		271,000 00
Ten-cent pieces		29,428,613 90
Five-cent pieces		4,880,219 40
Three-cent pieces		1,282,087 20
Total		$720,792,129 75

It thus appears that the Bland dollars coined since 1877 exceed in coining value all the other issues of silver money from the establishment of the Mint in 1792 to the present day.

Although Congress appropriated a sum of money ($40,000) to "pay the freight" on Bland dollars from the mints or subtreasuries to any part of the country, the Government has never succeeded in getting more than a small proportion of the vast accumu-



$50 gold piece. Augustus Humbert, United States assayer of gold, California, 1855. (887 thousandths.)

lation of Bland dollars into circulation. It became necessary, therefore, to construct enormous storage vaults of steel, some of which will hold more than one hundred million of these dollars. The depreciation in market value of silver in the Bland dollars and uncoined bars is estimated to be about $200,000,000.

The dropping of the original 412½-grain silver dollar from the law of 1873 was purposely done in order to make a place for the

new silver coin called the "trade dollar," ostensibly intended for foreign trade only, actually put into circulation to a large extent at home at a profit to silver owners. The "free coinage" privilege and falling market value of silver made these transactions remunerative.

$50 gold piece. Wass, Molitor & Co., 1855. (900 thousandths.)

Some people who accepted the trade dollars in good faith suffered loss.* This was the first entering wedge of the silver speculation which has attained such gigantic proportions.

The first coinage of the country was, in a measure, experimental; there were several different and very complicated finenesses, or proportions of precious metal and alloy, used. Then, in 1837, an admirably simple system of coinage proposed by Dr. Patterson was established. Later on various more or less absurd ideas were advanced and experiments were tried, such as the "goloid" dollars, consisting of silver and gold in proportions of 15½ to 1 and 24 to 1, invented and patented by Dr. W. W. Hubbell. Specimens of these freak coins were struck at the Philadelphia Mint in 1878.†

At the time that Congress was engaged in formulating laws for the establishment of the Mint and the regulation of the coinage in

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* Under the act of February 19, 1887, holders of trade dollars were permitted to exchange them for "Bland" dollars if presented at the Treasury, or any subtreasury, within six months from that date. Less than one fourth were thus redeemed (7,689,036), and since the expiration of the period of redemption trade dollars have been purchased as bullion, at the market price of silver, when presented at the mints. Although containing more silver than the Bland dollar, the trade dollar is worth less than half as much, owing to the low price of silver.

† Two different designs of goloid coins were struck:

1. The "goloid dollar," having the head of Liberty and motto "E Pluribus Unum" on the obverse, while on the reverse the following figures appear: 1 gold, 24 silver, .9 fine, 258 grains.

2. The "goloid metric dollar," having similar design on the obverse, and on the reverse the following figures: 15.3 gold, 236.7 silver, 28 copper, 14 grammes.

Proof specimens of these coins are preserved in the cabinet of the Mint in Philadelphia.

1792, the production of silver in this country was insignificant in amount. From 1845 to 1857 inclusive, the silver output is estimated to have been about $50,000 each year. As long ago as the year 1853 the production of gold amounted to $65,000,000, and the annual output has never equaled that amount since that time. In 1860 the silver product amounted in value to $150,000. In 1861 it jumped suddenly to $2,000,000, in the following year to $4,685,000, in the next year to $8,500,000, and so on, by leaps and bounds, until, in 1878, we were turning out about $45,000,000 worth of silver (commercial value) per annum. This was the real reason why the Bland bill for the restoration of the old silver dollar, weighing 412½ grains, was introduced into Congress and passed over the President's veto. It was then supposed that a maximum output of silver had been attained, but this was far from the fact. Production increased amazingly, even in the face of falling prices.

$10 gold piece. Clark, Gruber & Co., Denver, 1861.

In 1878, the year the Bland bill became law, the average price of pure silver was $1.15 an ounce, and the output from American mines was less than 35,000,000 fine ounces. In 1896 the average value of an ounce of fine (pure) silver was 67 cents, but the output of silver had risen to nearly 59,000,000 fine ounces. Since that time the price of silver has fallen still lower; to-day it is about 55½ cents per ounce.

In 1837, when the 412½-grain silver dollar was authorized, the pure silver contained therein (371¼ grains) was worth 100 cents in gold. To-day the pure silver in the Bland dollar is worth 42½ cents.

The value of any raw product depends mainly upon the relation between the production and consumption; when this remains constant the price of the commodity varies but little.

The commercial ratio of silver to gold has been carefully determined by Dr. A. Soetbeer, the renowned statistician, from the years 1687 to 1832; by Pixley and Abell from 1832 to 1878; and after the latter date by the daily cablegrams from London to the Bureau of the Mint. These tables show that the ratio between silver and gold vibrated between the limits of a trifle below 15 to 1 and 16 to 1 for nearly two centuries. In 1873 the ratio was almost exactly 16 to 1; then the great flood of silver began to pour out from the famous Comstock lode and other mines in the West, so that production soon far exceeded consumption. The Government was com-

pelled by the "Bland" act of February, 1878, to purchase silver at the rate of "not less than $2,000,000 worth per month." This continued without interruption for twelve years (from 1878 to 1890), during which time more than four hundred million silver dollars were coined. The Sherman act, repealing the coining of the Bland dollars, really made matters worse, in some respects, as it authorized the purchase by the Government of not less than 4,500,000 ounces of silver per month, and 168,674,682.53 fine ounces were purchased in four years (1891–1894) at a cost to the Government of $155,931,002.25, under the act of July 14, 1890. The average price paid for this silver was almost 92½ cents per ounce. At the present market price (55½ cents per ounce) there is a depreciation in value of $62,316,553.45 on the silver pigs purchased under this act. Notwithstanding these heroic efforts to sustain the price of silver through the compulsory purchase by the Government of such vast quantities of the metal, the flood continued rising higher and higher while the price descended lower and lower, thus proving that silver obeys the law of all commodities, and that any attempt to sustain the price by artificial means, even when backed by such a rich and powerful Government, and carried out on such a great scale, must surely fail.*

Coining of Gold.—If the question should now be asked you, "What denomination of gold money of the United States has been most largely coined since the establishment of the Mint in 1792?" you would probably say, "The gold dollar, of course." The answer would be wrong—very wrong. Less than twenty million gold dollars in all have been struck, and their coinage has been entirely discontinued for nearly ten years. If, on the other hand, the question should be asked, "Which denomination of gold money has been coined most sparingly?" you would probably say, "The double eagle." Again the answer would be wrong.

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* Circular No. 143 (dated July 1, 1897), issued by the United States Treasury Department, says (page 63): "The stock of gold and silver in the world in 1873 and 1896 is estimated to have been as follows:

	1873.	1896.
Gold	$3,045,000,000	$4,100,000,000
Silver	1,817,000,000	4,200,000,000"

The commercial value of silver in 1896 was less than one half of its value per ounce fine in 1873; notwithstanding this great fall in price, the estimated value of silver in the world in 1896 exceeded the estimated value of gold at that time, while in 1873 the estimated value of silver was only 59½ per cent of the estimated value of the gold in the world. Stated in other terms, the gain in estimated value of gold is 34.65 per cent, while the gain in estimated value of silver in the same period is 131 per cent.

Although the double eagle was not authorized until 1849, fifty-seven years after the act which authorized the eagle, half eagle, and quarter eagle, more double eagles have been coined than of any other denomination of gold, and the intrinsic value thereof is more than twice that of all the other gold coins put together. The total value of all gold coined in the United States Mints, except the double eagles, from the organization of the Mint in 1792 to June 30, 1897, is $548,840,918. The value of the double eagles coined since 1850 (the first year of their coinage) to June 30, 1897, is $1,337,498,040.

A circular issued by the United States Treasury Department says, "The total coinage of gold by the mints of the United States from 1792 to June 30, 1897, is $1,886,338,958, of which it is estimated that $671,676,250 is now in existence as coin in the United States." The pamphlet explains in detail the basis upon which the estimate of the gold coin in the United States was established, and says, "It will be seen that more than two thirds of the gold coins struck at the mints of the United States have disappeared from circulation." This is an astounding statement. What has become of all this vast store of gold, amounting in value to $1,214,662,708, or more than ninety per cent of the value of the entire issue of double eagles?

It is not a mere theory of mine that the disappearance from circulation of about two thirds in value of all the gold coins struck at

$20 gold piece. Clark, Gruber & Co., Denver, 1861.

the mints of the United States is due in part to the preponderance of coinage of double eagles. Thirty-seven years ago the director of the Mint called attention to the matter in his official report as follows: "The chief design of a National Mint is to subserve the interests of the people at large preferably to a few large owners of bullion or coin. The interests of the public and of depositors are not always concurrent in the matter under discussion. . . . The plain effect of issuing gold coin of a large size is to keep down the circulation of specie, and increase the use of paper money."

In the director's report for the year 1880 I find the following: "In Great Britain the gold coinage consists almost wholly of sovereigns and half-sovereigns; in France, of twenty and ten franc pieces; and in Germany, of ten-mark pieces, all of these coins being of less value than five dollars. The absorption by France of $1,100,000,000 of gold imports into her circulation during the thirty years from 1850 to 1880 may in part be accounted for by the coinage of nearly all this gold into denominations of less than two and four dollars value."

$10 gold piece. Pike's Peak gold. Clark, Gruber & Co., Denver, 1860.

The average coinage value of double eagles during the past four years has been over $44,000,000 a year, as compared with a yearly average value during the same period of about $10,000,000 in eagles, $4,000,000 in half eagles, and $30,000 in quarter eagles! It thus appears that we are still coining two thirds of our gold into double eagles that never pass into circulation and disappear immediately.* If, instead of pursuing this short-sighted policy for so many years, the people had been encouraged, by the issue of small denominations, on the return to specie payments in 1879, to circulate gold instead of paper, the gold could not have been so readily drained away from this country to foreign lands as has unfortunately happened on a great scale during the past few years.

If these words shall produce any impression upon those in authority, and thus lead to a modification of our coinage laws or customs in this regard, the attempt I have here made to combine with an academical discussion of the curiosities of American coinage some practical suggestions for improvement therein may not prove altogether futile.

For nearly fifty years we have been coining double eagles (not to

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* The following table shows the gold coinage executed at the mints of the United States during the fiscal year ended June 30, 1897:

Denomination.	Number.	Value.
Double eagles	2,990,241	$59,804,820
Eagles	804,301	8,043,010
Half eagles	747,802	3,739,010
Quarter eagles	23,946	59,865
Total gold	4,566,290	$71,646,705

mention eagles) that are, as a rule, immediately shipped to Europe; there they go at once to the melting pot, and are converted into British sovereigns (having a different proportion of alloy) or into gold coins of other nations; as soon as the rate of exchange changes beyond a certain degree these brand-new foreign gold coins are to some extent shipped back to us, and they in turn go to the melting pot at the Mint, where the proportion of alloy is again changed to make the standard of the United States (nine tenths fine). The gold is then recoined, shipped back to Europe, and so the process is repeated indefinitely.

In addition to the large expense involved in this useless and endless work there is irrevocable loss of precious metal with each handling, melting, and coining. I believe that all this is unnecessary. It would be perfectly feasible for the nations to agree upon some simpler method of adjusting trade balances at a tithe of this cost; and even if the time shall not yet have come for making such settlements by a sort of international clearing house, a partial solution of the difficulty would be found in the adoption of an international gold coin, or in the more general employment for export of fine gold bars instead of coin, which have been assayed at the mints or United States assay offices and officially stamped with their weight and fineness. There is less risk of loss by robbery in transshipment of such bars, and counterfeiting is not likely to prove a dangerous impediment for several reasons, one of which is that such bars do not pass into general circulation.

It is, of course, necessary, before we can hope to interest foreign governments in any improvement in international monetary matters, that we should adopt a reform in our own currency, bringing order out of the present chaotic condition.

In conclusion, I desire to call your particular attention to the valuable collection of early American coins, as well as coins of other nations, deposited in this museum by Mr. Robert C. H. Brock, of Philadelphia, from which the director, Mr. Culin, has had the illustrations made. This collection is rich in specimens of all the issues mentioned, and they are in excellent preservation.

ONE of the entries in Sir Andrew Ramsay's diary, quoted by Sir Archibald Geikie in his memoir of that geologist, describes a meeting of the Geological Society in London, when "Buckland made a most witty speech. It was about crinoids; and he began by saying that the debate seemed to him to have more of a gastronomic than a paleontological character; for all that had been said bore upon the relation of the plates to the mouth and the mouth to the plates." At a subsequent meeting "Buckland was all in favor, but in attempting to quote Scripture made a great mull of it, greatly to the amusement of all, especially the Bishop of Oxford."

THE NATIONALIZATION OF THE RAILROADS IN SWITZERLAND.

By M. HORACE MICHELI.

ON the 20th of February, 1898, the Swiss people accepted by an overwhelming majority a law referred to them providing for the purchase and operation by the state of the railroads of the country. The vote marks the end in Switzerland of the system of private management of railroads, and the coming in of a new system of state management. The action is one of interest and importance to all people everywhere, because it evolves momentous political and financial as well as economical and social considerations.

The agitation of the question whether the railroads should be constructed and managed by the state began in Switzerland almost with the beginning of railroad building. The first railroad, from Basle to Baden (Switzerland), was opened in 1847. A plan for the construction of a system of railroads by the confederation and the cantons concurrently, prepared by the federal council at the suggestion of the national council, was rejected by the national council, which voted in July, 1852, by a large majority, in favor of construction by private companies, under charters issued by the cantons with the approval of the confederation. This condition was not satisfactory to the federal authorities, and a law was passed in 1872 enlarging the powers of the confederation and giving it the control of the concessions. That law, with supplementary provisions making it stronger, has continued in force till the present time.

All the concessions, both cantonal and federal, contained provisions looking to the ultimate repurchase of the railroads, opportunity for which was given at certain stated intervals (apparently every fifteen years) upon five years' previous notice. On the coming of the first of these periods of maturity, in 1883, the question of repurchase was raised in the federal council, but the financial condition of the railroads not being very good then, no action was taken. This opportunity having been allowed to pass, no other would be afforded till 1898. Still, the friends of the national system pushed their measures, urging that the state enter into friendly negotiations with the railroads for buying them in, or buy enough of their stock to secure control of the disposition. Tentatives were made in both these directions, but they all came to an end in one way or another before any material results were accomplished. Then the idea of expropriation was started, its advocates maintaining that the state was not bound by the limitations in the concessions, but could take the railroads at any time upon paying a just price. The federal coun-

cil did not accept this view, and preparations were begun for exercising the right of purchase in 1898. The federal chambers in 1892 commissioned the federal council to consider measures looking to this end—that is, to prepare legislation that would give the confederation advantages in the transaction. In 1895, a law was passed requiring stockholders to register six months before voting in the company meetings. This, it was thought, would reduce the vote of the foreign stockholders, but it had the opposite effect, for the small Swiss holders would not take the trouble to register, while the large holders abroad did. The same law gave the confederation and the cantons the nomination of representatives who should have power to vote in the companies' directories. In the same year a bill was introduced requiring the railroad companies to present exact accounts of the condition of their lines and their management, with a provision suppressing the special tribunals provided for in some of the charters for the arbitration of differences between the state and the companies, and giving their jurisdiction to the federal tribunal. The purpose of this law of accountability was to meet the stipulation in the charters of the railroads that the state, in buying them in, should pay the companies twenty-five times the value of the net annual revenue of the roads as determined by the average of the preceding ten years, while it should in no case be less than the capitalized value of the plant of the company. It was sought to secure more accurate determinations of the "net annual revenue" and the "value of the plant" on which the amount paid on purchase was to be based. This bill was fought both by the adversaries of purchase and by those who insisted that the transaction should be carried through according to law and without violation of the rights that had been acquired by the existing proprietors of the railways. The latter objected that it modified all in favor of the state clauses of the charters—bilateral contracts that bore the signature of the state. The partisans of the bill denied that the concessions were of the nature of a bilateral contract. They held that a railway concession was a law, an act of the sovereignty of the state which created, it was true, acquired rights, but which the state could always modify so long as it did not violate the acquired rights; and that the proposed law of accountability violated no right. The majority of the chambers took this view, and the act was passed March 27, 1896. A referendum was called for, and the act was approved by the people after an exciting campaign, 223,228 electors voting *aye*, and 176,577 *no*, out of a total of 714,033 entitled to vote.

The acceptance by the people of the law of accountability opened the way for ultimately buying in the lines. While some persons probably voted for accountability who did not really favor purchase,

but because they thought the law in itself a good measure, the result was in effect a moral victory for nationalization. Furthermore, the new law, of its own force, by suppressing some of the guarantees which had been given the companies in the concessions, improved the situation of the confederacy as to the measure of repurchase, and removed some of the difficulties that had stood in the way of the consummation of the scheme. Immediately upon the adoption of the law of accountability by the people, the party who had theretofore demanded the nationalization of the railroads by expropriation placed themselves on the side of repurchase on the basis of the concessions. In their opinion, there was no longer any danger of purchase on those terms being too advantageous to the shareholders or too onerous to the state, the law of accountability, as they believed, giving the state power enough in adjusting the cost of the transfer. Previous to the adoption of this law the socialistic party had issued a demand for the initiative toward expropriation of the railroads; but although more than fifty thousand signatures—the number constitutionally required for the referendum—had been secured for their petition, its authors withdrew it, in order that the partisans of nationalization might not be divided upon a question of methods.

As the next term when the state could take the railroads would fall, as to most of the companies, in the spring of 1898, the federal council had no time to lose if it would avail itself of a vote of the chambers and of the people in favor of purchase. The law of accountability went into force on the first day of November, 1896. On the 25th of March, 1897, the federal council laid before the federal chambers the draft of a law for the purchase and operation of the railroads by the confederation, with a long explanatory address.

This draft contemplated the repurchase at the earliest period named in the concessions, and the subsequent operation of the five principal Swiss railway systems—the Jura Simplon, the Central, the Northeastern, the Swiss Union, and the St. Gothard. The lines belonging to these five companies had an aggregate length of 2,578 kilometres, and represented all the principal constituents of the railway system of the country. Only a few secondary lines of normal gauge and the narrow gauge and mountain railroads would remain in the hands of their original proprietors. The bill provided for the accomplishment of the acquisition in conformity with the federal legislation and the concessions, and proposed that the federal council be likewise authorized, with the consent of the federal assembly, to buy the lines mentioned as excepted, in conformity with the regulations for determining the purchase price. The confederation should procure the funds necessary for the acquisition of the railroads and their operation by the issue of bonds redeemable in sixty years or in

accordance with a previously arranged table of redemptions. The draft also provided that the accounts of the federal railroads should be kept distinct from the other branches of administration, so that the financial situation in respect to them could be exactly ascertained at any time. Their net revenue should be employed, first, for the payment of interest and the extinction of the railroad debt; thus serving to supplement the annual returns and making possible a reduction of rates for transportation.

It was provided that the management of the federal railroads should constitute a special division of the federal administration, and should be subject to the supervision and control of the federal authorities; but when it came to arranging the details under this category, the federal assembly made some important changes, which were embodied in the law as it passed.

To the federal assembly was reserved the power of examining and approving the annual accounts on the reports of the management; deciding, with the reservation of the referendum, concerning the construction of new lines and the acquisition of existing ones.

To the federal council was given authority to draft regulations for the execution of the present law; to name twenty-five members of the administrative council, the members of the general direction, and the members of the arrondissement directories; to approve the annual budget; and to present to the federal chambers the annual accounts and the reports of the management, as well as propositions relative to the construction of new lines and the acquisition of existing ones; and to continue the exercise of functions already possessed by it respecting private lines, so far as those functions are applicable to the federal railroads.

As special to the working of the railroads and with functions extending over the whole system, were instituted the administrative council and the general direction; the administrative council to be composed of fifty-five members appointed for three years: twenty-five by the federal council, twenty-five by the cantons, and five by the arrondissement councils—the federal council so to adjust its nominations that agriculture, commerce, and industry should be equitably represented in the body. This administrative council was given the supervision of the whole administration of the railroads and the functions of preparing the annual budget for submission to the federal council; of examining the annual accounts and reports of operation for submission to the federal council; of fixing rates, classifying merchandise, and making regulations for the time schedules; of satisfying all important agreements made with other railroad enterprises; of preparing the plans for new lines, expensive constructions, and the completion of important works in the system in

operation; of approving contracts involving more than five hundred thousand francs; of ratifying the appointments of chiefs of service, and the fixing of their compensation within the limits of the law and the budget; of the determination of the general conditions on which persons employed shall be engaged; and of examining propositions relative to the construction of new lines and the modifications that may be needed in legislation respecting the federal railroads. It further had the naming of a permanent commission charged with the preliminary examination of affairs—of six members—of which its own president was the chairman.

The general direction was composed of from five to seven members to be named by the federal council, sitting at Berne, holding office for six years, and having its president and vice-president chosen by the federal council. To it, subordinate to the federal authorities and the administrative council, was given the work of management, the preparation of the annual budget, the establishment of the accounts, the making of the report of management, the preparation of the business to be submitted to the administrative council, the carrying out of the directions of that body, the preparation of regulations, tariffs, and time schedules; the control of the receipts from working and the material; with the making of agreements subject to the ratification of the administrative council, and the appointment of functionaries who are directly responsible to it.

The federal system was divided into five arrondissements, localized at Lausanne, Basle, Lucerne, Zurich, and St. Galle; with at the head of each arrondissement an arrondissement directory of three members appointed by the federal council, each administering the arrondissement of which it is in charge. These directories were each supplemented by an arrondissement council of four members appointed by the federal council and from eleven to sixteen members by the cantons constituting the council. The creation of these supplementary councils was a concession to the federalists, but more apparent than real, for the functions conferred upon them were extremely modest, and consisted in giving their opinion on questions relating to the railroad service, approving of the annual budgets and accounts prepared for submission to the general directory, determining upon all credits not exceeding one hundred thousand francs not provided for in the annual budget, approving the reports of the arrondissement directories, and the right conferred upon each of them to appoint one member of the administrative council.

The organization of the future federal railroads, therefore, notwithstanding the apparent concessions to the cantons, was strongly centralized. All important decisions were placed under the control of the general direction and the arrondissement directions, the mem-

bers of all of which were directly dependent upon the federal council, which could appoint, control, and, on occasion, remove them.

Certain promises had to be made in the law to satisfy different regions having extensions of lines in view that their works would not be neglected. The most important of these extensions was the Simplon Tunnel, which the Jura Simplon road was just about to undertake, and in which French Switzerland was deeply interested. The law pledged the confederacy to complete this. The eastern cantons had extensions and passages of the Alps in view, and provision was made for these, a special guarantee being given to St. Galle for the construction of the Ricken line. To meet expressed fears that the secondary lines, if not cared for by the confederation, becoming unprofitable, would be abandoned, a stipulation was inserted providing for their purchase in the future without the necessity of a new referendum. The act as finally adopted by the chambers was regarded by those in favor of the purchase as a happy compromise which would rally all parts of the country to the support of the great national measure. The adversaries of the scheme regarded it as a great deal, intended not to improve the plan but to gain votes for it and make it acceptable to a coalition of interests. But it is certain that the object sought by the majority was obtained, and the amendments silenced the most active of the opposition. Party discipline was also brought to bear against dissent, and all the radical left except one deputy voted for it on its final passage. The majority by which it was accepted was further made up of the extreme socialistic left, a part of the center, and a small fraction of the left. The opposing minority was made up of the larger part of the Catholic and federalist left and a part of the liberal center.

The enactments relative to service on the railways make Swiss citizens residing in Switzerland alone admissible. The term is three years, and all in the service, together with the members of the administrative council, the general directory, and the arrondissement directories, are removable by those who appoint them.

A pension and assistance fund for the officers and men employed is provided for, to be kept up, half by the contributing members and half by appropriations from the management fund; its statutes to be established by the federal council. The existing pension and assistance funds may be continued if thought best, but their members can not at the same time be members of the general fund.

In a message accompanying the submission of its project to the federal chambers, the federal council presented as a first argument in its favor the saving it would effect of the time, labor, and absolutely useless expenditure involved in carrying separate transactions between five different companies and in maintaining their several

special organizations and offices. Further, great advantages would be gained in the matter of support and supervision of the lines, the security of the traffic, easier adjustment of time schedules, and international relations, if a single administration was created. The local service would be ameliorated, for a single administration would be able to give the unproductive lines advantages realized on the productive ones, while private companies would naturally serve the productive lines first, and do no more than was indispensable—often, indeed, than the least provided for in the concessions—for the secondary lines.

To the advantages derived from consolidation would accrue those arising from administration by the state, which would look to securing a working advantageous to the whole public, while to private companies the advantage of stockholders would always be sought first. It would be able to effect desired reforms in rates, making them uniform where they were now various, often to a considerable degree, with inconvenient complications arising.

The necessity of gradually extinguishing the capitalized obligations of the railways was insisted upon. By about the middle of the next century the countries around Switzerland would be in possession of unincumbered systems, provisions to bring such a result about being already in operation in France, Prussia, Austria, etc. Switzerland ought to follow the example of these nations, else it would then find itself in an inferior position as to them. They would be able, among other things, to make great reductions in their tariffs, which, if Switzerland could not meet them, would expose it to disastrous competition. The extinction of the railroad debt should be attended to now. If it was put off till the next time purchase would be possible, or till 1913, there would be no possibility of completing the enterprise before the middle of the century. It was further held to be necessary to rid the railroads of the foreign influences to which they were subject because of so large a part of their stock and obligations being held by capitalists abroad, a condition politically mischievous and humiliating to the country; and the flow of money out of the country in dividends to these alien holders would be stopped.

Other arguments were addressed to particular classes, especially to the men employed on the lines, to whom the particular advantages of state service over private were held out in all their tempting aspects.

The law of repurchases having passed, October 15, 1897, the opposition to it canvassed all the cantons in order to obtain the thirty thousand signatures required by the Constitution of the republic to secure its reference to a direct vote of the people. Consid-

erably more than that number were obtained, and the referendum was appointed to be made February 20, 1898. An active discussion of the merits of the scheme was going on all the time, and continued till the vote was taken. The several parties now took their positions on the subject.

The socialistic party had been for many years most ardent advocates of the nationalization of the railroads, but were not fully pleased with the plan of the chambers, because it gave too much control of the direction and too much power to the federal council. They would have preferred to have the administrative organs more independent of the political authority, and to have them, in part at least, named by the people. Yet they thought it would be contrary to their principles and their previous record to oppose a scheme which took so valuable a property from private companies to give it to the state. Assent to the measure was supported at the convention of the party in Zurich, November 14th, with strong arguments, by Mr. Wullschleger, of the national council, notwithstanding all the amendments he had offered in the council with a view to making the law more consonant with their ideas had been rejected; and a long resolution was unanimously adopted without discussion demanding the purchase as an essential article of the socialistic programme and a victory over capitalism, and an active propaganda in favor of the law was instituted.

The radical party, the party in power, controlling large majorities in both chambers, and responsible for the passage of this law, was committed to it by the very nature of the situation, and was especially strong in its favor in German Switzerland. Yet there was some opposition to it within the party, particularly in French Switzerland. But the mass of the radical opponents were ultimately won over to favor the purchase. M. Numa Droz, however, ex-president of the confederation, held out to the end, published a remarkable pamphlet, and spoke against the purchase in the principal towns of French Switzerland. He held a few adherents, but the radical meetings as a whole voted for purchase, and the general convention at Berne, December 12th, adopted an address of considerable length recommending it. The mass of the opponents of purchase in the chambers was composed of the Catholic right, and their attitude was dictated by motives of principle. They were adverse to a large extension of the functions of the confederation, opposed nationalization as a dangerous arm to put in the hands of the central power, and brought considerations of financial prudence to bear on the question. Still, some of them were gained over, and in two of the cantons they made an active campaign in favor of the measure.

The federal Catholics were also against purchase, and in their

convention at Berne, December 16th, recommended the rejection of the scheme.

The conservative liberal party, alone of the more important Swiss parties, had no organization extending through all the cantons. It was composed of cantonal groups who found themselves in general agreement on federal questions, and were most numerous in the Protestant cantons. They made an energetic campaign against purchase.

Parties divide themselves, in Switzerland, on most questions, according to their centralistic or unitary, or their federalistic tendencies. The centralists seek the progressive unification of the nation, and would give the utmost power to the central authorities, at the expense of the cantons; while the federalists, regarding the historical traditions of Switzerland, would preserve to the cantons the power left them by the Constitution of 1874, and contend, step by step, against any rupture between the central power and the local authorities. These two tendencies were again ranged in conflict on the present occasion. Besides objections to any disturbance of the present relations between the cantons and the federal authority, other considerations were urged in the discussions before the people against the principle of the nationalization of railroads. The management of the railroads, some said, should not be committed to the state, because it is not one of its proper functions, and because of the wrong of exposing its finances to the risks inherent in such a combination. The state goes out of its sphere when it undertakes to manage transportation. Its mission is to defend the interests of the public by exercising an effective supervision over the administration of the private companies. Further, mischievous results were to be feared from the influence of politics over railroad management. State management might be a good thing if it was inspired solely by regard for the general interests of the country; the lines should be administered in a commercial spirit. With the railroads in the hands of the state, political influences would operate in the appointment of functionaries, the arrangement of time schedules, the adjustment of rates, and the construction of new lines, and their effects could only be disastrous. The control of so considerable a financial administration would also be detrimental to general politics. Entering into political discussions, it would make them more complicated and bitter; and the central power would be able to exercise a considerable pressure on the deputies in the chambers and on the electors themselves. Those who feared the effect of such influence on parliamentary independence and on the freedom of the vote of the people ought, therefore, to reject the project.

Economical and financial arguments were also extensively used by the opponents of purchase, and were brought forward with much force in two pamphlets which created much sensation in the country—one by ex-President Numa Droz, and the other by Dr. J. Steiger. The question was asked in these publications whether the railroads, in the hands of the confederation, would yield a financial return that would permit the realization of the hopes of improvement in the service without risk to other interests of the confederation to which the project of purchase had given rise. They reviewed the propositions which the federal council had emitted on this subject, and attempted to show that it had failed to take account of several items which might tend to increase the expenditure side of the budget. No allowance had been made for the expenses of improvement and construction and completion of the lines, which had cost the five companies thirteen million francs a year; or for the cost of tunneling the Simplon and making the eastern extensions that were promised; or for the loss of receipts that would be incurred through the promised reduction of rates. It seemed a probable result of the calculations made by the authors that the working-expense budget of the federal railroads would have to bear a considerable deficiency, which would not permit the extinction of the debt by the middle of the next century, but would rather tend to increase it. In order, therefore, to avoid too great annual deficits, the federal administration would have to work the railroads in a spirit of the strictest economy, and instead of reducing rates might have to raise them. There were no provisions in the law to prevent this, all propositions to insert them having been rejected.

MM. Droz, Steiger, and those who agreed with them held, therefore, that the purchase would be a bad financial operation for the state. And, then, would it not be dangerous for a small country like Switzerland to contract an enormous debt which it would be difficult to extinguish and of which it might at most only pay the interest? Might not the existence of considerable obligations, partly held abroad, compromise the financial independence of the confederation? Why run these risks when the necessity of economizing might prevent the confederation from fulfilling the promises of which the partisans of purchase had been lavish in its name?

Some of the other arguments urged in the discussion were less legitimate, and some appealed to prejudices which exist, it seems, in Switzerland as well as in America, against corporations and foreign bondholders. The campaign was one of the most exciting that had been witnessed for a long time in the republic. During January and February, 1898, public opinion was occupied with no other question. Numerous public meetings were held in all the cantons, pamphlets

were freely circulated, and the newspapers took a very active part in the matter.

The vote was taken February 20th. Out of 734,000 citizens entitled to vote, 570,000 exercised their right. The result was a surprise to all. The measure was carried by a vote of 386,634 to 182,718, 200,000 majority, or by more than two to one, when few anticipated a difference of more than 50,000 or 80,000, and some persons considering themselves well informed thought, even the day before the voting, that the scheme would be rejected.

Only a year before—February 28, 1897—the Swiss people had voted against a project for a state bank which had been recommended to them by the same parties that advocated state railroads. Still, we can not infer from this that the people have reversed their position and favored a state socialism this year which they rejected last. The motives that determined their vote seem to be of a different order. The majority of the electors evidently regarded the railroads as a public service of the same kind as the post office, telegraph, etc., and sought to remove all private influences and sense of personal benefit from their management, as well as to free it from foreign influence. The mass of the people trusted to the promises held out of reduction in rates and improvements in all the features of the service. The men employed on the roads exerted a strong and solid influence in favor of the purchase, because they believed they would fare better in the hands of the state than under private owners.

By the vote of the 20th of February the Swiss people have made a decision of extreme importance, which will be certain to react upon the whole political, economical, and social life of the country. It is now for the federal council to see the law carried into effect. On the 22d of February it withdrew the concessions from a part of the Northeastern lines. If the repurchase goes on successively according to the terms of the concessions, the confederation will secure possession of the Jura Simplon, Central, Northeastern, and Swiss Union systems in 1903, and of the St. Gothard in 1909. For the purchase of the St. Gothard, negotiations will have to be gone into with Germany and Italy, which furnished considerable subsidies for the construction of the line; and it is further possible that the confederation will secure possession of the whole network before 1903 if it decides to negotiate with the companies, as the law authorizes it to do. If it does not do this, and does not succeed in coming to an understanding as to the price, the federal tribunal will be called upon to decide important questions relative to the calculation of the indemnities to be paid to the stockholders.

The experiment which Switzerland is trying is certainly very instructive. It will be interesting to observe how the confederation

will manage to procure the capital required for its purchase and for running the railroads. It will be especially interesting to see whether it will be able to keep the promises that have been made in its name, and to compare private management under the control of the state with direct management by the state in a democratic country.—*Translated and abridged for the Popular Science Monthly from the Musée Social.*

THE EVOLUTION OF COLONIES.

By JAMES COLLIER.

III.—IMMIGRANTS AND INDIGENES.

FROM the simplest plant to the heart and brain of the world's chief denizen the organic kingdoms are the prey of a myriad parasites. These are outsiders and insiders, living in or upon the skin of their host, or burying themselves in its cavities and tissues, bones and vital organs. They are strongest and most numerous in the lower species, which can offer least resistance. If the *Epizoa* are sometimes accidentally useful, the class as a whole is injurious. But they are not less destructive to themselves. They sink in the scale of being through atrophy of their parts till they are no longer recognizable. What is the sociological significance of this strange blot on the face of Nature? It has been ingeniously suggested * that parasitism is the insurrection of the vanquished lowest species against the higher species that have supplanted them in the possession of the earth; and the view may be found as philosophical as it is picturesque.

Commensalism arises when, besides living by their means, if no longer at their cost, the inferior species render a service to the superior. Certain crustaceans eat the excrement of fishes, and thus purify the water. One species of birds hunts parasites in the crocodile's throat, another clears the elephant's back of them. The scavenger vulture and hyena banquet on the remains of the carnivore's feast. The struggle for existence between two species, direct in parasitism, is indirect in commensalism.

Rivalry gives place to coalition. Different species of birds ally for safety. The sentinel ostrich warns troops of gazelles, zebras, and quaggas. Conversely, the Abyssinian damon unconsciously protects the lizard and ichneumon. Mutualism is a prophecy of the coexistence of alien peoples.

These three types of relationship among animals—parasitism,

* By M. Alfred Espinas. Sociétés animales, first edition, pp. 21, 22.

commensalism, and mutualism—exhaust the possible forms of relationship between the immigrants who land in a new country and the indigenes whom they find there.

I. Desert islands or other unoccupied portions of the earth's surface having been at all times scarce, outside the books of Rousseau and Defoe, the would-be settlers in a promised or desired land have usually found themselves face to face with a native people in prior occupation of the soil. Like the penguins on the Auckland Islands, or the birds in the Australian forest, these peoples have no instinctive fear of the white man. They are not shy nor without provocation hostile. They are eager to trade, willing to sell their land, glad to have the foreigner in their midst. Things do not run smoothly very long. The natives, being still imperfectly initiated in the distinction between *meum* and *tuum*, "convey" the white man's coveted possessions. Harsh reprisals convert the black or the red man's passions into mere powder magazines. Or the rape of some red or black Helen fires another Troy. Realizing at last that it is *pro focis* they have to fight, they unite against the Yenghese or the Pakeha as they have never united against one another. The warfare has different fortunes in different ages. It was impossible before the invention of arms of precision, so that America could not have been colonized had there been an earlier Columbus. It was at its hardest in the sixteenth and seventeenth centuries, when the weapons of civilization were but little superior to those of barbarism. It is at its easiest now, when the breechloader has first made man the undisputed lord of creation, alike over wild beasts and wilder men. The issue grows daily more assured with every new invention, and Marconi's discovery hastens the advent of the era of omnipotent science imagined by Renan, when, like the mere gaze of the Brahman, the very approach or the most distant action of a scientifically equipped community will insure its victory over a barbaric race.

The resulting peace is sometimes enduring. The Massachusetts treaty with Massasoit was loyally observed for over half a century; the pacification of the Maoris lasted for twelve or fourteen years—an almost equal space of time in our swifter age. But it gets always broken sooner or later, and usually by one grand peace-breaker. When Chief-Justice Marshall ruled that the declaration of sovereignty over a territory carried with it, subject to the rights of prior occupancy, the paramount ownership of all land within that territory, he laid down a principle that has proved the fruitful mother of native wars in every quarter of the globe. Not that it has ever been universally accepted. Roger Williams disavowed it beforehand. The British Government has ostensibly acted on a very different canon. And

there has been in every colony a strong minority, at times converting itself into a majority, to which the landed rights of the natives were sacred. None the less has Marshall's decision been the nerve of every colonizing advance. In the spirit of it the colonial legislatures pass laws and the courts make rules for the acquisition of native lands; doubtful sales are made by unauthorized members of tribes; not overscrupulous governments and altogether unscrupulous private individuals acquire wide tracts; the natives see their land slipping away from them; if they are not to become landless fugitives, they must make a final stand. Hence there is, almost always, in the relations with savage peoples, a second war; this time *pro aris*—for their right to keep the land which is, as it were, an extension of their tribal selves; to take which is to wound, dismember, or destroy them. Such was the cause of the native insurrections in North America in the first half of the eighteenth century, of the Maori war of the sixties, of the Matabele rising the other day, of a dozen different savage rebellions. The colonists summon up their power for a decisive struggle, and the natives are again beaten. On the colonial side there has been a profuse sacrifice of life, villages burned and towns destroyed; on the native side, a ruin still more terrible. Two thirds of the population may have been killed, as in Hispaniola; tribes have been broken up; the soul of a people has been slain.

The mother country has all this while not looked on at the spectacle with listless eyes or folded hands. In general it may be said that the degree of compassion felt for the natives is in exact proportion to the distance of the sympathizers from the objects of their sympathy. The colonists of the North Island of New Zealand, everywhere in peril from the Maoris and eager for their lands, have always been strongly anti-Maori; those of the South Island, perfectly disinterested and out of danger, are nobly philo-Maori; while the home Government, thirteen thousand miles away, has been from first to last the strenuous defender of the Maori. It is an "undoubted maxim," said Mr. Gladstone in 1846, "that the crown should stand in all matters between the colonists and the natives." Nine years earlier a committee of the House of Commons declared, possibly by the same eloquent voice, that England "will tolerate no scheme which implies violence or fraud in taking possession of . . . territory, will no longer subject itself to the guilt of conniving at oppression, and will take upon itself the task of defending those who are too weak and too ignorant to defend themselves." To this honorable line of action the British Government, outside of India, has, until lately, steadfastly adhered. It reluctantly annexed the islands of New Zealand, to save the natives from the settlers. It resisted the interested

clamors of a powerful and avaricious company to annul the treaty of Waitangi, which secured the Maoris in possession of their lands. It appointed successive protectors of the aborigines—incorruptible officials like the late Walter Mantell. It sent out governors whose first duty was to the natives and only their second to the colonists; and the reality of the guardianship is shown by the facts that it led to the recall of one Governor, made a second resign, and got a third so constantly into hot water with his ministers that he too was recalled. Other governments have acted similarly. The wrongs of the Mexicans reached the tender heart of Isabella, who did the little that she could to modify the ferocity of her subjects; Las Casas was appointed protector of the Indians. Certain others have a more dubious record. M. de Varigny claims that merciless suppression and brutal repression are alike repugnant to the French character. Neither was always repugnant. It is barely half a century since Pelissier smoked the Arabs in Algerian caves. "The welfare of my service requires," commanded Louis XIV, "that the number of the Iroquois should be diminished as much as possible"; they were to be shipped for galley slaves. In 1736 the welfare of Louisiana required that the Chickasaws should be reduced, and two years were unsuccessfully given to that end. Severity is still less alien to the German character. In 1892 and 1897 two governors of German East Africa were recalled for applying too literally the avowed maxim of one of them that the lower races were to be governed by "the stick"; and a few months ago a third German administrator was called to account for cruelty to the Africans.

Public opinion in the mother country is usually divided; a single cross-section will show in what ways. "The agnostics don't send missionaries to Cochin China," cries the pulpit; North America was not colonized by the sensualistic school of philosophy, dogmatizes Bancroft. Yet the leaders of these very schools champion the cause of the oppressed. When Governor Eyre and his subordinates were prosecuted in 1866 for having suppressed a negro rebellion in Jamaica with needless cruelty, it was Mill, then at the height of his fame, who instituted the prosecution, and he was backed by Spencer, not yet at the meridian of a career that was to eclipse Mill's, and by Huxley, coiner of the word *agnostic*. Is it that there is a close connection between a belief in evolution and a fellow-feeling for the lower races from which we sprang? On the same side were the radicals, advocates of political freedom, the philanthropists, the "nonconformist conscience," and the evangelicals, who believe that negroes have souls. The opposite side was led by Carlyle, fresh from Frederick and his peculiar methods; Ruskin, with lance in rest against a new windmill; idolized Tennyson; Kingsley and

Froude at heart, if not in act—England's best and greatest on the spiritualistic side; men to whom the distance between the white and the colored races was infinite, investing the former with absolute rights. With them were the military and official classes, high churchmen and conservatives generally.

Sometimes there is a humanitarian sentiment in the air, as in that same year when a chief justice could charge violently against the Jamaica authorities, and the Tory leader (then Lord Robert Cecil) was so far carried away as to lament that white men held the lives of others cheap because they had a black skin. It is far otherwise now. High-handed modes of building up an empire enlist many defenders. "You can not make an omelette without breaking the eggs," cynically quotes M. Cherbuliez. Clive would find few calumniators in our days. Hastings would run no risk of impeachment. Dupleix would not be sacrificed. Frere would not be recalled. The protests of the Aborigines Protection Society against Stanley's "wading through slaughter to" Emin raise no echo. The humanitarian wave of the last generation is spent.

The devil's advocate has always plenty to say for himself. The savages practiced sanguinary rites, like the Ashantis and the Dahomans. They were the allies of our enemies, like the Hurons (say the English), like the Iroquois (say the French). They were already exterminating themselves, like the red Indians and Maoris, when we interposed and saved the remnant. They were being destroyed by strong drink and swindled by landsharks, like these same Maoris. They were a disturbing element on our frontier, like the Afridis. They were naked and bestial and a gang of murderers, like all the East Africans. They were a hindrance to the occupation of the soil—in short, they kept the land we wanted to take. "The starving white man must be satisfied," frankly confesses Mr. Stanley, "or he will grow ugly."

The would-be saint's advocate has some difficulty in replying. He condemns, even now, the fraud, injustice, and oppression that are the foundation stones of British India. At a far greater distance of time he still condemns the ruthless exterminating war against man and beast which the Hebrew's waged in Canaan. He listens with sympathy to Emerson's manly protest against the deportation of the Cherokees, and to Richard Howitt's and William Howitt's diatribes against colonization as giving the lie to Christianity. He reads (with an effort) the earnest *plaidoyer* in behalf of the Maoris which Mr. Rusden calls a History of New Zealand. He acknowledges it to be the glory of the sex that the three most powerful appeals ever made for justice to a native race have been made by women—in world-famous Uncle Tom's Cabin, Mrs. Helen Hunt Jackson's pathetic Ramona,

and Olive Schreiner's thrilling story, Peter Halket. He notes with respect the attitude of the honest official who resigns his office because of unfulfilled promises to the natives of a whole island, or that of the private citizen who refuses to subscribe to the Imperial Institute because of unrepaired injustice to a single tribe. He is, nevertheless, obliged to admit, with the sage of Concord, that these things "look very differently to the centuries and to the years." The whole religious future of the world was bound up with the Hebrew conquest of Canaan, of which the ruthless barbarity may have been a necessary incident. The British occupation of India is a shining fact in history. The colonization of the savage-ridden spaces of the globe has swamped the inevitable accompanying crimes with a flood of benefits. A territory belongs by right divine to the race that can most profitably occupy it. But even in Nature's Jesuitism the end does not justify the means. Every step toward it must be just. All treaties must be honestly contracted and loyally observed, all promises kept, all rights respected. There shall be no personal injustice or oppression. Where the balance seems equally poised, the native scale shall be weighted. Pre-eminently, the surrender or confiscation of land shall correspond rather to the decline of the indigenes than to the increase of the colonists.

It would be easier to prove the converse and show that the decline of the natives has followed the loss of their lands. Yet history reveals a surprising amount of equity in transactions where the colonists were under no compulsion. In New England every acre was long scrupulously paid for; and this was the case in other States, as Parkman has shown. In New Zealand millions of acres have been purchased by the Government at a reasonable price. Laws were passed and courts set up in both countries to protect the natives. Where purchase was impracticable, as with the nomadic Australian blacks, the colonial Government has assumed a benevolent trusteeship. It has provided food and clothing, houses, implements and land, hospitals, doctors and medicine, schools and churches. The southern Maoris have been treated with less tardy and more compulsory benevolence. All such are parasites at the table of their invaders—interlopers on the lands they once freely roamed over or rudely cultivated. The more savage indigenes who live on the frontier of settlements, like many red Indian tribes so long, like the last integral fragment of the Maoris in the wild Uriwera country, like the blacks of the Australian north and northwest, have but rare relations with the colonists. They may swoop down from their fastnesses or crowd in from the forest, and threaten or imperil or destroy a colony, thus resembling epidemics of typhus and cholera, which are literally invasions of bacteria; but these descents become ever fewer as the natives grow

weaker and the colonists are better able to cope with them. In a peaceful state they resemble the *Epizoa* and may even, like that class of animal parasites, render accidental services by teaching the colonists certain kinds of cultivation, as the Indians taught the New-Englanders to grow maize and the Maoris taught the New-Zealanders to grow sweet potatoes.

Some of these colonial parasites, having received a start, become self-supporting by tilling the lands that have been graciously left them. These become almost alien elements in the young society, slightly connected with it through government superintendence or missionary labor, as the Maoris or Blackfellows, or altogether unconnected with it, as the Arabs and Kabyles of Algeria. Their nomadic and more dependent kinsmen are true commensals in that they live, as in Australia, on the offal of animals newly killed by settlers, some milk given them, and the use of their dogs for hunting; or, as in South America, they receive from the Government used-up horses for food. They render services in return. The South American *rastreador*, the black police of Queensland, and the hundreds of black trackers who have followed criminals into the bush with extraordinary skill and no little courage, are the human parallels of many species of birds.

We rise to mutualism when the lower races are employed as troops, and this has its degrees. They are used as combatants in their own ways, like the red Indians during the wars between the French and English in North America in the last century, the tame South American Indians in the war against the wild Indians in 1832, and the Hottentots in South Africa in 1859. There is more organization in the Houssas and other African troops now enlisted on the Gold Coast. The Bengal Lancers and the once dangerous Sikh infantry are the pride of British India; and the ferocious Apaches have lately been trained into obedient and disciplined soldiers. All colored peoples are employed as carriers, and many as guides, boatmen, divers, and what not. The reciprocity or the rivalry of play is perhaps higher than that of work or fighting. The Australian blacks have defeated a white team at cricket, and the Maori footballer ranks high in a footballing colony.

II. The immediate effect of the contact with white immigrants is invariably disastrous and in certain cases fatal to the indigenes. The law has been correctly stated by Mr. Benjamin Kidd. Wherever the climate is so temperate that white men can not only reside and work but also multiply, the native race in occupation must inevitably disappear. An addendum is, however, needed. The limit of such residence is no hard-and-fast line, but a vanishing point, which is being driven ever nearer the equator and nearer the poles. French

settlers accustom themselves to Lower Canada and to Algeria, American to Alaska and Texas, English to Nova Scotia and Guiana. Australian farmers are not deterred by 120° in New South Wales. Queensland sugar planters are multiplying in the tropics. Gold diggers rush equally to torrid Coolgardie and frozen Klondike. Within these wide limits the indigenous races are everywhere melting away. They are merely the last of the vanquished. The softer native grasses have been eaten out by the sturdy European grasses. Native plants have been exterminated by imported plants or driven to the hills. The Norway rat has expelled the native rat. The moa is to be found only in museums; the emu, the kangaroo, and the wallaby are in full retreat. None of them can make a living in competition with stronger species. It is not otherwise with man. The white man destroys the black man's game or cultivates the red man's land, and both are driven into the sterile interior. By some undiscovered correlation the birth rate adjusts itself to the food supply, and few children are born. Other causes are assigned, but they might be shown to be a continuation of causes in operation before the white immigration. The chief cause is the effect on the reproductive system. To it mainly is due the decline of the Hawaiians, Maoris, and Australian blacks during the present century, of which statistics have been kept. Even where food is supplied, the decline continues. Like the ancient Hebrews and other Eastern nationalities, like the inhabitants of mediæval villages, like Circassians and Cherokees—forcible dislocations which but continued their own involuntary migrations—the surviving Tasmanian aboriginals were transported to an island in Bass's Strait, the change apparently precipitating the decline, for children ceased to be born; the remnant was brought back to their native island, which, twelve years ago, witnessed the total extinction of a once vigorous race.

A people may disappear by absorption, aiding extinction. There was a time in the history of French Canada when it was on the point of realizing the Jesuit ideal of a continent inhabited by a mixed race of reds and whites. The missionaries Samuel Marsden and Lawry, the eminent governor, Sir George Grey, and a well-informed writer in the Edinburgh Review, believed that a blended race of Maoris and English would dwell in the islands of the Southern Cross. How far the colony is now from so undesirable a consummation will appear from the fact that fewer than five thousand half-castes are sown through a population of seven hundred and twenty thousand. There is, however, a steady advance in their numbers. While the pure-blooded Maoris have in five years declined by one eleventh, the number of half-castes has in the same period increased by nearly one sixth. The figures relating to the blacks of New South Wales are

still more striking. There has been a continuous decrease of the full-bloods and a steady increase of the half-breeds, so that in the present year the latter have at length overtaken the former. The miscegenation has its picturesque incidents. The regal dignity of Montezuma clothes with barbaric grandeur two noble Spanish houses; the blood of Pocahontas flows proudly in Virginian veins; beauty visibly descends from the valor of Rauparaha, and prestige has not deserted the offspring of Te Heu Heu. It may be looked upon as the undesigned atonement which the immigrant makes to the aboriginal for robbing him of his country; and the amount of mixed blood is at length the aboriginal's sole share in the population of the land he once monopolized.

The agencies accelerating or retarding the inevitable progression toward the two *termini* have an interest melancholy or cheering, but superficial. The white man's drink, diseases, vices, and crimes are partly offset by the benefits of imperial trusteeship, missionary labor, and the contagion of white settlement. The first is real but distant; the value of the second is chiefly initial, and the action of the last is powerful but unconscious. The home government is beneficent when it protects the natives from the avarice of the settlers, and often maleficent in the guise of beneficence, as in the "insensate negrophilism" of the English at Sierra Leone, or in the sad comedy of conferring French citizenship on the blacks of Senegal and the Antilles. The utility of missionary work is much contested in the colonies, where it can not be denied that the missionaries have done well for themselves and their families. Even clergymen, from Sydney Smith to Canon Isaac Taylor, have exulted over "the great missionary failure." Whatever may be the case in India or Africa, throughout one wide colonizing region—that of the South Seas—this great failure has been an unquestionable success. A whole race, in a variety of families—Hawaiians, Tahitans, Tongans, Samoans, and Maoris—has been raised several degrees in the scale of civilization. Missionaries, and they alone, have done this great thing. Yet, as with the mocking finale to Heine's finest songs, one has to qualify this high eulogy by asking whether they have not smoothed the path of these people to the grave. They have paved the way for colonization by breaking down the resistance of the natives, and they have insured that a warlike race shall die ingloriously in its bed. The influence of the surrounding settlers begins where that of the missionaries leaves off. Governed by imitation, the natives procure seeds, implements, and cattle, and farm like whites. This stage lasts as long as they keep their land; when from misfortune it goes, the tribe is gone. At this stage there may be much mimicry of civilization: the younger members may distinguish themselves at colonial schools and

colleges, the elder as legislators and bishops; there may be land works and water mills, printing presses and newspapers; they may even increase in numbers. When it passes, they sink into parasites. Like other parasites, they lose their original characteristics. The Talleyrands and Metternichs whom Bishop Hadfield was acquainted with in New Zealand, and the chiefs whom Maning found as great in their own world as Pompeius and Cæsar in theirs, have disappeared like those ancient worthies. The Maori can no longer wield the *merè* nor the Australian the boomerang.

III. The destructive effect of the parasite on its host has its parallel in the reaction on the individuals of higher races who come in contact with the indigenes. The residence of some of these precedes systematic colonization. Of one hundred and fifty *pakehas* scattered over the North Island of New Zealand before it was annexed—runaway sailors, escaped convicts, and other loose characters —the best known was one Rutherford, an English sailor, whom the Maoris forced to stay with them, tattooed, gave two daughters of a chief to wife, and kept among them for years, living in all outward respects like a savage, till at last he made his escape. That he did not quite sink spiritually to the level of his captors is shown by the interesting account of their habits and customs which he dictated to Prof. G. L. Craik, afterward incorporated by him in his valuable New-Zealanders of 1830. In every way the most remarkable was the famous Frederick Edward Maning. What motive—whim, disappointment, disgust with civilization, or latent savagery in himself—induced an educated man of superior abilities to cast in his lot with a race of cannibals has not transpired. A son of Anak, and possessing rare force of character, he was able for many years to hold his own in a community whose laws were more terrible than lawlessness. Such a man can never have been other than an alien at heart, but with his Maori wives, and conforming to Maori usages (cannibalism, it is to be hoped, excepted), he was outwardly a barbarian. He too broke away at last, and when colonization advanced, his knowledge and experience amply fitted him for the difficult post of a native land court judge. It fitted him still better for writing the most vivid account of a native race that has ever been thrown into literature. A more pathetic case is that of a professor of classics in Columbia College, New York, who, from disgust with the world, led a life of savage isolation in Queensland, where fifteen years ago he was speared by the blacks. The North American continent has seen crowds of such men. Daniel Boone was a type of the trapper who was half Indian. General Sam Houston, who had been adopted by the Cherokees as a boy, returned to his adopted father's tribe after he had made himself unpopular in Congress, assumed its dress, and lived with it for

three years. Lewis Morgan naturalized himself as an Iroquois in order to study the social structure of that people. Parkman qualified himself to be the historian of the same dying race by the rough initiation of actual residence, and the story of miscegenation that he tells seems to borrow some of its fascination from observation at close quarters. There were remains of it when he wrote (in 1851), but its flourishing days belong to a full century earlier. Then the French immigrants gave prophetic confirmation of Bismarck's *mot*, "Scratch a Frenchman, and you come upon the red Indian." Red Indians they became. "The manners of savages," wrote one of them, "are perfectly agreeable to my palate." They were adopted members of Indian tribes, had squaws and reared a dusky brood, decorated and painted, danced, hunted, and took scalps; even Count Frontenac, Governor of Canada, plumed and painted, danced and yelled. Naturally, they sank to the moral level of their associates, caught their habits, imbibed their prejudices, drank in their superstitions. Frontenac burned Iroquois prisoners; Lovigny tortured Iroquois ambassadors to death. More tragical still, the fugitives from civilization, or those who had been captured by Indians, when found and brought back, sat sullen and angry, and escaped when they could to the free forest life. Women who had been carried off from New England villages in childhood were recovered and fêted, but soon fled to their warriors and Indian children. When we condemn the savages who have reverted to their old life after being inured to civilized ways we forget the hundreds of whites who have made a far greater drop. The deterioration resembles that of horses, cattle, and other domesticated animals that have been turned adrift or broken loose in a wild country. Its degree differs in different races. The instinctive repugnance which makes it so hard for an Englishman to govern sympathetically any race but his own is here his safeguard. He intermarries or worse, but does not so greatly sink. He either disentangles himself or raises his partner to his own level. His household then becomes a normal English home.

As the savage eats the heart of his slain enemy to acquire his courage, have we miscegenated the lower races unto ourselves to gain something of the unique qualities they possess? It is impossible that the infiltration of their blood into that of a colony, weeded out as it soon is, should not proportionately affect the sentiments, beliefs, and actions of the young community. There are even writers who maintain that there can be no real interracial influence without intermixture. What part has the alien element played in deeply Indianized Lower Canada? How much of his genius does the naturalist, psychologist, and novelist with whom Canada dowered England owe to the strain of Indian blood in him? The Spanish-American, Gar-

cilasso de la Vega, is a unique example of a blend yielding a historian of the races blended.

Whether due to interbreeding or to mere coexistence, the part of the primitive races in contemporary civilization is being daily aggrandized. The so-called Aryan peoples are shown to be a mere prolongation of the neolithic races. A number of specialists adduce evidence from laws of succession, folklore, archaic customs, and archæological remains to prove that existing British institutions strike their roots down through Teutonic invaders and their Celtic forerunners to races that occupied the soil ages before.

The reactions of the lower indigenous peoples on their conquerors have been of a more spiritual sort. They have been phonographed in the vast literature bequeathed by the navigators and travelers, missionaries, military and naval officers, civil officers, and settlers who have visited or been resident among them. How extensive that literature is will appear from the fact that the bibliography of a single colony with less than sixty years of existence, and less than eight hundred thousand of a population, contains over twelve hundred articles. This great quarry is of incommensurable but unequal value: 1. It is often uncritical. The facts have not been accurately reported, as has been shown in detail of the Tasmanians; or they have been misinterpreted, as when a group of obscene songs have been published as Maori myths; or (as Mr. Taylor has proved) missionaries have imported their own theological beliefs into their accounts of the beliefs of savages. 2. Much of it is unsympathetic. Observers have not imported enough. They have failed to see in these peoples men with feelings and thoughts akin to their own. The savage's fetich worship and the barbarian's Nature worship are far from being the wild absurdities they are sometimes represented to be, but are as rational as the Calvinism and Wordsworthism which are their offspring. The more we know of the lower races, as of the lower animals, the more we discover that all organic Nature was made (as Newton put it) "at one cast." 3. It is not always scientific. There are few travelers like Humboldt or Darwin, few missionaries like Taylor or Callaway, few officials like Schoolcraft, nor in the absence of special researches do even these know what to look for or what questions to ask. Hence races perish or institutions disappear before their secret has been wrung from them. Perverse science is as mischievous as none. A foregone conclusion made of Lewis Morgan's ponderous volume on the classificatory system of Indian relationships a monument of misapplied ingenuity. Led astray by the same Will-o'-the-wisp, two instructed inquirers discovered among the Australian blacks the existence of polygamy on a scale that out-Solomons Solomon. Future researches will be better guided. Twenty years ago the British Asso-

ciation issued a list of queries, and students of special subjects have catechised missionaries and other residents abroad.

On these foundations has been reared what Max Müller disdainfully names agriology, what the late Mr. Freeman, the historian, invidiously styled "Mr. Taylor's science," and what is, in fact, the science of sociology. In its pre-scientific stage it consisted of premature generalizations on an insufficient basis of facts, such as are to be found in the still interesting works of Goguet and De Brosses, Monboddo and Kaimes. Sometimes it gave rise to a great idea in other sciences. Observing the poverty-stricken flora and fauna of Australia, Cook mused on the agencies which kept the Australians within the limits of subsistence. His speculations dropped in Malthus's pregnant mind the seed of the law of population. As is better known, that law put into Darwin's hands the key to organic evolution. Cook begat Malthus and Malthus begat Darwin—that is the genealogy of natural selection. Special researches began. Prof. John Millar's Origin of Ranks, of which the third edition was published so long ago as 1781, shows how near a man may be to a discovery without making it. Only after eighty years did his inchoate speculation issue in the most finished piece of inductive research that sociology has to show—McLennan's Primitive Marriage. Mr. Tylor, the best-equipped and most judicious of contemporary sociographers, has skillfully tracked social phenomena on a dozen different lines all round the globe. And these pioneers have been followed by a host of explorers, from Florence to Stockholm and from Moscow to San Francisco. Systematic science at last arrives. Comte named and rightly placed sociology in the circle, or the tree, of the sciences, and his prior treatise is enriched with a wealth of thought unequaled since Montesquieu. But his construction is vitiated by the mechanical conception of society that bore such Dead Sea fruit in the Politique; and without the indispensable foundations supplied by a study of primitive peoples it is a mere "Spanish castle," a structure in the air. A vital conception of society and the tracing of existing institutions, rites, and ideas to their roots in these peoples made Herbert Spencer the true founder of sociology. The carving out of the social subsciences—a task that baffled the keen intellect of Mill—was struck off by this great thinker at a heat. The classification which forms the skeleton of his Descriptive Sociology is an analytical masterpiece that evoked the enthusiasm of Taine. As it has already been made by two able assistants (Dr. Duncan and Dr. Scheppig) the framework of exhaustive descriptions of the savage and semi-civilized races, so will it be the schema of all future sociological research.

Art as well as science has been born of the contact with indigenes.

A contemporary artist has happily cought the "idea" of the Indian maiden—so mysterious, so near to Nature, so remote from ourselves. Chateaubriand has embalmed in Atala the sentiment of the primitive forest; Longfellow, in Hiawatha, has distilled the romance of Indian life; and in Ranolf and Amohia Domett has transported to the Hot Lakes the loves of Juan and Haidee. A legion of novelists, from Saint-Pierre to Pierre Loti and Louis Becke, has described one side or other of the relationship. Governments and manners have been revolutionized by the contact. From travelers' tales, embellished at the start and further idealized by his own imagination, Rousseau drew "those oracles which set the world in flame." It is not unchristian to hope that the overlordship of the whole earth now first arrogated by the whites, with the high beneficent trusteeship in favor of its indigenes which that involves, will react on the sensibilities of the overlord and issue in a humaner evolution. Is it anti-Darwinism to expect that the mad rivalry and savage warfare of every man against his fellows—with its hecatombs of wrecked lives and broken hearts deadlier far than that elder warfare of spear and tomahawk—will at length give place to a co-operation that will be more zealous for the rights of others than solicitous for its own?

THE NATION'S CRISIS.

By A. B. RONNE.

"I THINK that, whatever difficulties they may have to surmount, and whatever tribulations they may have to pass through, the Americans may reasonably look forward to a time when they will have produced a civilization grander than any the world has known." These were some of the parting words with which Herbert Spencer bade this country farewell after his short visit in 1882; they form the concluding sentences in that memorable interview which he granted a representative of our press a few days before his departure.

It must still be fresh in the memories of Mr. Spencer's many friends on this side of the Atlantic that in this interview he freely discussed the numerous signs of an immense development of material civilization which everywhere confronted him here, without concealing the fact, however, that while the wealth and magnificence of our large cities had been a source of astonishment to him, these very evidences of a wonderful commercial activity and development of arts had constantly reminded him of the Italian republics of the middle ages, where the people under circumstances and conditions similar to ours were gradually losing their freedom.

It will also be remembered that Mr. Spencer's visit, owing to ill health, had been a hurried one, and that he offered his views as the result of his first impressions only. But of the symptoms in our public life which most impressed him as pointing toward the undermining of free institutions, he mentioned the tyranny of the political machine, under which the citizen, as a rule, had to use his political power according to the dictates of party managers, or else to throw it away; and in this connection he reminded his interviewer of the fact that "constitutions are not made, but grow," that the Americans got their form of government more by a happy accident than by a normal progress, and that here, as it has been elsewhere, it was becoming painfully evident that our political structure, as an artificially devised system, had been growing into something different from that intended. Yet, in spite of all this, Mr. Spencer did not seem to take a very doleful view of our future. From the size of our country and the heterogeneity of its components he thought it safe to predict that, as a nation, we would be long in evolving our ultimate form; but that this ultimate form would be high, considering all that we had accomplished and the troubles over which we had already triumphed, he saw no reason to doubt; and thus he dismissed his interviewer with the prophetic words quoted above.

Scarcely sixteen years have passed since this interview took place, but signs are not wanting to-day which show that during this brief period we have gone from bad to worse, not only in regard to those evils referred to, but to others of a like nature as well. From all our principal cities come startling disclosures of boss rule and its accompanying political corruption. Yet it is difficult to say which is the most startling—the corruption itself, or the apathy toward it evinced by the masses. In New York city the disclosures a few years ago were followed by a tidal wave of municipal reform, but after receding this wave seems to have left the great city in a condition little improved if any. The recent accounts from Pennsylvania furnished us by Mr. Wanamaker, whatever effect they may have on the elections in that State, are of far less interest to the average citizen than the news from Washington, although the dangers implied in the former threaten the most vital interests of the Commonwealth. But, if, in places, the Commonwealths are groaning under political corruption of the worst kind, the country as a whole is groaning under an industrial depression, the causes of which do not seem in any way to concern the professional politician, except perhaps when political capital may be made from taking up the question. As to these causes thoughtful men may differ. But upon this they all must agree: that corporate capital during the last sixteen years has become more and more tyrannical, while the wage-earners—

mechanic and laborer alike—once supposed to furnish the brains as well as the brawn of this republic, have become more and more dependent. And here, again, we meet with the same apathy among those not directly interested. Gigantic strikes, one after the other, this country has witnessed since 1882, in which public sympathy at the beginning has been with the striking workingman, only to be transferred to the side of the rapacious corporation—already backed by the executive and judicial branches of the Government—just as soon as the inconvenience of the situation began to make itself felt by all: the result of it all being a large middle class, insensible to the encroachments on their personal freedom on the one hand, and a dissatisfied, disgruntled working element without faith or confidence in our political institutions on the other.

Under such conditions this war with Spain may truly be said to have found us unprepared, not so much from the lack of an adequate navy or standing army as from the absence of a real national unity. It is generally held that—war having commenced—it is unpatriotic to discuss now whether it was justifiable or not; it certainly is useless, and we may as well accept the situation as unavoidable and the war as a righteous one. It may seem strange, therefore, perhaps unkind, to speak of the absence of national unity in the face of the vigorous preparations made by the administration and the willing response to its call for volunteers by our young men in all parts of the country. Yet the thoughtful man can not shut his eyes or ears to the chaotic state of opinion concerning the war and its causes, and for the sake of the future of this nation it is well to take a sober look at the situation. A war is always a crisis in a nation's history, especially so when its traditional policy has been one of peace. Earnest appeals to patriotism and humanitarian principles have not been wanting; but side by side with the many responses to these appeals, grumblings and bitter fault-findings have been heard. The professional politician, as might be expected, has come in for his share of alleged responsibility—his supposed aim being personal gain or glory—though, strangely enough, the political leaders who usually are the targets for the attacks of the professional reformer were the most anxious to avert the conflict. No more satisfying is the charge that our politicians in Washington, who were chiefly instrumental in working up the war feeling, were actuated only by a desire to stem the tide of Bryanism by diverting public attention from this movement—seeing that its brilliant leader and some of his henchmen were as clamorous for war and military glory as any of the rest; while the silver organs did not hesitate in stigmatizing the President's efforts toward settling the difficulty through diplomacy as being in the interest of Wall Street.

But the strongest proof of the absence of the genuine national unity which should characterize a righteous war is, perhaps, the indifference noticed among the working people. This has been commented on in several newspapers, and an explanation has been sought in the fact that a large part of our foreign population has not as yet sufficiently imbibed the spirit of our institutions to make them good Americans. The real explanation, however, is the fact that through actual experience they are learning that war can only result in making their struggle for existence still harder, partly by the paralyzing of many industries and partly by enhancing their cost of living. Can a lofty and self-sacrificing patriotism be expected from those who, in their struggles with aggressive capital intrenched behind governmental protection, have invariably suffered the fate of the vanquished? And they who have learned that it is less against foreign aggressions that eternal vigilance is required than against the insidious growth of domestic interferences with personal liberty—should they blame them so very much?

It being granted that this war was unavoidable, that humanitarian principles no less than self-interest compelled this country to make this departure from a time-honored policy, this allusion to its unfavorable internal conditions is made only for the sake of pointing out the real danger of the hour. As already remarked, this war presents a crisis—we stand at a crossway, and it is now that we must choose whether our destination is to be that higher civilization predicted for us by Mr. Spencer, or whether we shall turn back toward a purely military *régime*. That there is grave danger of choosing the latter is seen in the changed sentiments throughout the country. Many well-meaning people who a short time ago deprecated the idea of war altogether, and who rejected with scorn and indignation the insinuation or open charges by European powers that our real object was one of conquest, have been, through the first success in the East, carried away by the alluring spectacle of the United States assuming the position of the greatest naval power of the earth, and as entering upon a new career as "a fulfillment of its appointed mission." It was truly said at the time by a New York journal: "The American spirit is stirred and its imagination inflamed by the opportunities now offered this country to extend the sphere of its power and influence." But what does all this mean? It means that, when the war is over and victory ours, then the people, drunk with military success, will be ready to sell their birthright for a mess of pottage. In their delirium they will have no adequate idea of the cost of maintaining a standing army and a navy second to none. So far from being frightened by the strong centralized government made necessary by these changed conditions, they will hail with loud

acclamations the military hero with the most picturesque trappings as the man sent by a special providence to lead and to guide us, and thus a long step forward—or backward—to monarchical institutions will have been taken.

Is this picture overdrawn? Will it be said that this is the prediction of a warped, a fretful and pessimistic mind? Not by the sober and the thoughtful. Signs pointing that way are too numerous, sentiments of such a nature abound in the daily press; even the religious sentiment here and there is prone to lend encouragement to the idea of special providence in this matter of a new mission for the United States—that of spreading the light of civilization among semibarbarous people, east and west, by the help of fire and the sword. Who this "man on horseback" is to be is now and then clearly indicated. That he may be a man of high attainments, of personal integrity and nobility of mind, does not help the case; he is a relic of a chivalric, it may be, but still a barbaric past. Only such a man can fearlessly advocate, in season and out of season, the necessity of a navy equal or superior to that of Great Britain, knowing as he must that the resultant national self-consciousness of brute strength is ever prone to lead a government to aggressive acts both at home and abroad. And what is to pay us for this sacrifice of personal liberty? Is it the increased trade with foreign nations? Is it the increased industrial activity, made necessary by caring for distant colonies? Too late will it be learned that the only way to national prosperity lies in attending, as far as possible, to our own affairs; in guarding faithfully the rights of every citizen; and in encouraging, first and last, friendly relations with foreign powers. The nation, doing all this, will soon find itself strong enough in the internal unity, resulting from the contentment among all of its citizens and through the moral effect this must have on others, to defy any encroachments and to ward off any insults or impositions from the outside, though it may not have a gigantic army or navy sapping its very life blood.

It is held by some who are aware of the possible dangers here alluded to, that there is really no serious cause for alarm—the great merit of a democracy like ours, according to such, being the assured fact that "out of its multitudes, who have all had a chance for development, there will always arise, when occasion demands it, stronger and wiser men than any class-governed societies have ever bred." This, however, is begging the very question at issue. For now has the critical time arrived, when it is to be ascertained how far the insidious growth of class government has affected our nation. Strong men we have, and wise men, too; the first are already coming to the front, but—and this is one of the ominous symptoms—there is a disposition whenever the latter are heard to cry them down

as traitors. Yet, it is only by heeding the warnings from these sober-minded men, in whatever station of life we may find them, that we shall be able to choose the right road to follow. Do we wish to show the monarchies of Europe that they were wrong in charging us with base and selfish motives? Do we really wish to show the world that in this republic individual character—that which Herbert Spencer told us, sixteen years ago, is the first essential in fitting men for free institutions—is not wanting; that the average American citizen "has a sufficiently quick sense of his own claims, and at the same time, as a necessary consequence, a sufficiently quick sense of the claims of others"? If we do, let us heed the voice of those who bid us beware of the false glamour of military glory. In the history of every young nation, as well as of the individual, there is always sure to come a time when its destiny is to be decided forever; when success in choosing the right means further growth toward a higher and fuller life, and failure means nothing but eventual decay. At such a time this nation has now arrived—

"At the crossway stand'st thou; choose!"

THE PHILOSOPHY OF MANUAL TRAINING.

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IV.—THE RESULTS OF MANUAL TRAINING.

IN looking at the actual and possible results of manual training, I come to one of the most attractive aspects of my subject. I find these results, in the main, to be very favorable, but I should be unwilling to use this as an argument for manual training unless it could be shown at the same time that there was an organic relation between these results and the underlying principles. Many of our current social and economic fallacies owe their too long life to just such an appeal to results. The underlying philosophy of manual training might be quite false, and its methods quite unpsychological, and yet the entire scheme in the hands of devoted men and women might be so far modified and colored as to give admirable results. And I am the less willing to use this argument because I should not admit the propriety of its application in the case of unfavorable results. Could the actual results of manual training be shown to be poor, or at least indifferent, I should conclude that it had missed its mark, and had been badly carried out, and not that manual training itself was a poor scheme. It would be quite possible for manual training to be a perfectly sound scheme of education, and the one best

qualified to develop the individual and national life, and yet in the hands of men and women who did not understand its end and purpose, to give results so meager and undesirable as to make the whole scheme seem to stand self-convicted.

And I find lurking somewhere in the corner of my mind a second reason for this disclaimer. I should be unwilling to have the manual training movement, which seems to me so full of seriousness and of promise, suffer in your esteem by reason of the aberrations of any of its less enlightened exponents. We are sometimes murdered in the houses of our friends. And manual training, sloyd, and the kindergarten have suffered much at the hands of their friends. The real justification for manual training, let me repeat, is to be found, not in any aspect of its practice or results, but in a far deeper sense in that system of social ethics which grows out of an evolved philosophy of life. If this has seemed to you sound ground, the results flowing out of it must be equally sound. This may seem a somewhat sophisticated way of escaping a dilemma, but, believe me, it is nothing so trivial as that. It is a strong desire that your judgment should be on the essential and not on the accidental features of manual training, righteous judgment and not judgment according to appearances.

The human race is very old and human effort is very old; and education, whether systematic or unconscious, has been going on ever since the hand of man fashioned the little black tablet recently found by Dr. Hilprecht in Babylonia, and dating back to the sixth millennium before Christ. Education is a very old process, certainly eight or ten thousand years old, and probably very much older. It is, therefore, I think, entirely modest and reasonable, in speaking of anything so very modern as manual training, which in America can not yet claim a score of years in the matter of age, to speak both of the actual and possible results, since manual training has not been in existence long enough to have come to anything like its full powers. And yet these actual results have already attained very respectable dimensions. I feel constrained to add still one more word of caution. Not only has manual training not yet perfected itself as a tool, but even as an imperfect tool its term of service is at present limited to about three years, and the actual results, under the most favorable conditions, can not be regarded as more than a mere fragment of the possible results.

Knowledge is a perception of relations. We have agreed upon this, I think, as a sound definition. The coming into knowledge is the coming into a perception of these relations. The coming into life is a coming into a realization of self, and of one's relation to all that is not self—to other individuals, to the social order, to Nature, and to the Supreme Intelligence of the world. All that helps on this

perception of relations among outer things, and helps on the realization of one's own relation with the world that is not self, is in the highest degree educative. The process of education being the conscious direction of evolution, the creation of a definite environment in order to realize definite moral and æsthetic ends, must produce results, if any, just along these lines, must bring one into a perception of relations, must help one to realize self, and not less materially must help one to realize one's relation with a world that is not self. The results of manual training, so far as they are educational, must be along some such lines as these. Let us look at the results so far as knowledge is concerned—a perception of relations.

We can know about a thing, and we can know the thing itself. There is a tremendous difference. We can know about verbs and adverbs, nouns and adjectives, and all the rest of the nine parts of speech, and we can decline, compare, conjugate, analyze, parse. But we can never know the parts of speech themselves until we know them as a reality of use, until we experience them either in literature or in our own efforts at expression. We can know about the world and about foreign countries, and can form vague mental images to correspond to them, but we can not know the world itself or other lands except through travel, through actual experience. We can know about the world of matter, about rocks and minerals and animals and plants, and be well read in regard to their appearance and qualities, but we can only know this world of matter by personal contact. It is the same in a less material world. We can know about the emotions, about love and friendship and conscience and duty and hate and remorse, but we can not know the emotions themselves until we ourselves have felt. It is a very unreal world that is built upon the report of others, rather than upon the report of our own senses, a world in which books take the place of life, in which maps take the place of lands, in which pictures and drawings take the place of Nature and of art—a flat world of two dimensions, lacking the third dimension of solid reality. Those only can know who live in a world of reality and of direct sensational experience.

I am stating one of the actual results of manual training when I say that it not only attempts to bring boys and girls into touch with reality in thoughts and things, but that it truly does so. And it does so by letting them alone, by providing an environment rich in its invitations to action, but one in which the action must be self-directed. Furthermore, it is an environment in which the world is very meagerly reported, only so much as is absolutely necessary, but in which the boy is thrown back upon the reports of his own senses and must taste life at first hand. One can not live in such a world, can not be constantly doing things with one's hands and eyes, without

coming more and more to adapt means to end, without growing more and more into a realizing sense of the principle of cause and effect. In a manual training school there are, of course, stupid boys who never come into a full measure of knowledge, and there are clever boys who quite of their own self-activity would have come into a full measure of knowledge. Better than any training is it to be well born. But the average boy, neither stupid nor clever, is certainly aroused to a keener perception of relations—that is, into a deeper knowledge. The realization of self, the coming into possession and control of one's self, is a large developmental process which means many things. Take a boy as he is. Picture him as he might be. The realization of self means nothing less than the spanning of this considerable chasm. I do not for a moment believe that manual training accomplishes all of this, but I do believe that one of the actual results is to bring a boy out of his smaller into his larger self, and so points toward the realization of this ideal. The necessity for adapting means to ends forced on a boy by his manual work, the presence both of the principle and the idea of cause and effect which he meets at every turn, conspire to give him a very practical habit of mind, a habit which brings about a more complete adjustment of acts to ends than you will find in boys who have not had this special form of judgment training. And this complete adjustment, as we have seen, is the mark of highly evolved conduct. This result ought to follow from manual training, and I should in any case count it among the possible results, but our experience is now large enough to enable me to say that it does actually follow, and that it follows in large measure. I have watched the boys very carefully inside the schools themselves, have watched their habit of dealing with problems and facts, and I have followed their careers and kept in correspondence with hundreds of them after graduation, and I find them marked by a power of thought and action that quite differentiates them from ordinary boys.

I have been the head master in schools where manual training was taught and where it was not taught, and have had an opportunity, therefore, to come in contact with both classes of boys; and I have come to separate the two very distinctly in my mind, because I detect in them a marked difference of quality.

But while this nice adjustment of acts to ends constitutes highly evolved conduct, it is only touched with morality when the ends are moral—that is, are happiness-producing in a very deep and genuine sense. This disposes of an objection which is sometimes urged against the moral claims of manual training, and quite naturally urged, I think, that skillful workmen are not always good men, are indeed often men of quite impeachable moral habits. Without know-

ing in any statistical sense—and it would be almost impossible to collect such statistics—I am nevertheless disposed to believe that an essentially good workman is also a good man, for a love of good workmanship must beget a love for all else that is good and true. But without insisting on this view, it is enough to point out that manual training teaches the adjustment of acts to distinctly ethical ends—ends that involve the most complete self-realization, the full development of all the powers and faculties, and consequently to that full measure of life and happiness that is the goal of morality. And manual training leads to this result by a very direct path. All the manual work is undertaken for the sake of its mental reactions, and these reactions have a very definite character. The manual occupations are so arranged physiologically as to strengthen the brain centers controlling the extremities, and thus secure general increase of brain power. They are made as varied as possible in order to stimulate a many-sided interest. A greater number of boys remain to graduate in manual training schools than in the ordinary high schools. The general interest in life awakened in these boys is somewhat akin to the freshness and enthusiasm that you find in young children. The schools stimulate curiosity, and I use the word as Arnold used it, to mean intellectual interest. This result seems to me of large importance. We all have this curiosity when we are young. If the emotional life be strong, if desires grow apace with their gratification, we retain it to the end. Life remains a beautiful laboratory in which the invitation to investigate is forever strong. The drying up of the emotions, the loss of this curiosity, is the tragedy of old age. You have doubtless seen old men and women in whom the physical life is still sufficiently strong to keep them in motion, but in whom the psychical life, the desires and feelings and interests are completely dead. Do you know anything more tragic than this? I do not. It is one of the saddest sights of Europe to see the elderly men and women, many of them our compatriots, who are enduring Europe rather than enjoying it, who are dragging themselves from place to place in the vain thought that they are on the road to pleasure, men who have given their strength and manhood to money-getting, and who have let go, only to find that they have no interest and no genuine capacity for pleasure left to fall back upon; and women whose prime has been given to triviality, and who show in their faces the bitterness and *ennui* of old age. If I did not hate commercialism for its own sake as something quite unsocial and quite unworthy of the human spirit, I should hate it for the sake of these, its pitiful products. Who can not recall a succession of elderly men who have given up their business pursuits at the solicitation of their friends, and who have been rewarded in a very few years by death? You

know why they died. It was because the spirit was already dead. And who has not heard it said that Mr. Smith or Mr. Brown or Mr. Jones is kept alive by his business? In view of what men might be interested in, it seems to me a very poor and bare and altogether a pitiable thing to be kept alive on.

Manual training is still too new to have seen its generations of schoolboys grow gray-haired, and it may easily turn out that when gray hairs do come, the disintegrating forces will have done their perfect work, and the boys now so full of promise will be found among the sad company that I have been picturing. As Thoreau says, we begin to gather the materials for a palace, and end by building a hut. But I do know that at least they start out in life warm and eager, that they are aglow with interest and vitality, and that they find life very full and rich.

The session of the manual training school ends between two and three. In those schools where that spirit of the complete life most prevails, where that spirit of radiancy is dominant, you will find boys and masters still at work at four, at five, and even at six o'clock. And it is not uncommon for it to be necessary to make a rule when the boys must leave the building, in order to give the women a chance to make things clean and tidy for the next day. In the morning the boys begin coming at eight; they would come earlier if they were allowed. This voluntary devotion to the school is not to me without a deep significance. It shows that boys are happy at their work, that they are alive and interested. It indicates a measure of self-realization.

The increase of health which comes from the bodily exercise, and particularly the increase of muscular power that the manual work engenders—I mean muscular power not in an athletic sense so much as in a general organic sense—make the organism finer and better adapted to the work of the spirit, if I may use this dualistic phraseology without misleading any one. We can not make bricks without straw, and we can not build up emotional and intellectual power in the air. Like the energy which is the subject-matter of physics, this power is always associated with matter, may indeed be called the spiritual energy in matter, but with matter of a certain quality, highly organized, sensitive, sound. Dr. Johnson said that sick men were rascals, and I believe that he was more than half right. This statement will at once call to mind a goodly company of men and women, world heroes in fact, who were half invalids or wholly invalids, and who yet accomplished marvels in art, in science, and in humanity. But in no case can it be shown that this invalidism was in the brain tissue. The malady was of some special organ, and was perhaps a mortal malady, and yet for a time the brain centers

remained sound and intact. But even here the question is legitimate as to how much greater heroes they might have been had the weaknesses of the flesh not weighed so heavily. Such a statement, too, is apt to call up another and quite a different company of people, rosy-cheeked and bright-eyed, and as stupid as they make them. George Eliot's heroines, when they are beautiful, nearly all come to some bad end; and when they are plain, end by making you love them. Charlotte Brontë is given to the same association between outer ugliness and inner beauty. Even the genial Thackeray makes Amelia somewhat empty-headed. You may also be led to reflect that college athletes are not always the intellectual giants of later life. The honors still fall in part to the shabby, ill-favored men.

It would be easy to multiply this contradictory evidence, but my sole purpose is to make it clear that the problem is double-faced. How shall we get at the truth?

A favorite maxim of mine applies here very well. It is this, that what is true at all, is true in the extreme. It is a convenient practical process for testing all sorts of conclusions, and I recommend it to those who may, like myself, have little skill for more subtle processes. Applied to the case in hand, it would lead us to pass from the normal to both extremes of society. Let us then ask what is the motor sensibility of the beautiful but empty-headed heroines: do they play music that any one cares to hear; do they paint pictures that any one cares to look at; do they make fancywork that any one cares to receive; in a word, do they show any quickness of motion, do they do anything that would lead you to suspect a high degree of organization along with the anatomical perfectness? If your experience has been like mine, you have found them statuesque and clumsy. They make beautiful photographs, for it is perfectly natural for them to sit still. And you can quite as readily recall a series of men, handsome and dull, a delight to look at and a bore to talk to.

But going a step further from the normal, let us inquire into the mental capacity of rickety children. The testimony here is very sad. The inco-ordinated movements of the body are not a physical defect alone. They are a mental defect. There is the same lack of co-ordination in their mental processes. You know what secrets are let out in a simple handshake—the firm, strong grasp of the strong; the weak, flabby, repulsive touch of the weak. There are few teachers who have not wept bitter tears in spirit, if not in fact, over the little people whom they have come to care for, but in whom they have had to recognize that a deficient organism would forever bar the way to the highest achievements—children for whom there seemed but this one hope, that they might one day be born over again. I have known with some degree of intimacy about fifteen

hundred boys, and over periods ranging from a few months to as many years, and one can not know them and be interested in them without reaching a number of generalizations about them. I have come to be very fearful of the development of any boy who is markedly clumsy, and I have come as the result of experience to mistrust the reliability of his mental processes.

I am not fond of Calvin. I think he did little to set free the spirit of man. But I find in the limitations imposed by the bodily organism a predestination as real and as bitter as any that Calvin taught.

If we go one step further toward the extreme of acknowledged deficiency, we shall meet still more striking testimony. This pathological region is a most depressing one and to be entered unwillingly, but health has undoubtedly gained much by a study of disease. The localization of brain action has been established for psychologists by the study of abnormal cases and by accidents. Where death or the necessity for some surgical operation has made it possible to examine into the brain structure, the most intimate connection has always been found between function and organ, and between special function and special organ. A failure in the power of speech, or the loss of any special faculty brought about by sudden accident, can always be traced to the injury of some part of the brain tissue. Sometimes the injury is so vital that the tissue is completely impaired, and in that case I believe there is no hope of recovering the lost faculty. But sometimes an operation can restore the normal order. A clot of blood has perhaps been formed and presses against some center. When the clot is removed, and with it the undue pressure, the lost faculty is restored. You will find many such instances recorded in the pages of experimental psychologies. But the application for us, in studying the results of manual training, lies in the thought that the poor, undeveloped brain centers in the deficient might be strengthened by exercise brought about at the extremities. It is a logical suggestion. The bodily faculties are peripheral, the brain central. As a matter of experience, and as a necessary inference from our philosophy, the interaction between them is complete. The health of one means the health of the other.

Following this thought, manual training has been introduced as a therapeutic agent in the treatment of feeble-minded and deficient children, as at Elwyn, Pennsylvania, and in the treatment of the morally oblique, as at the Elmira Reformatory, New York. The results are now matters of statistics, and are probably in part known to you all. Nothing has been found quite so effective in concentrating the wandering attention of the feeble-minded and in co-ordinating their mental and bodily movements as just this manual activity. In

the treatment of the morally oblique, manual training has proved a veritable redeeming force. Dr. Barr, the chief physician at Elwyn, writes me: "The secret of the development of the imbecile lies undoubtedly in manual training. The schools for the feeble-minded in England and on the Continent, recognizing this, have gone far along this line, while we have wasted years in trying to force abstract theories upon mental defectives. Surely a truer thing was never said than 'The working hand makes strong the working brain.'" Mr. Bates, the director of manual training at the Elmira Reformatory, sends me the following striking letter:

"The influence of manual training processes upon the originally selected defectives was so marked that the Board of Managers unanimously decided to increase it so as to take five hundred of the special defectives, classed as follows:

"Group 1 are those mathematically defective, those who fail continuously in arithmetic, failures beginning with 'evening kindergarten,' and continuing into Set 1 and Set 2, in which advanced problems in percentage are taught.

"We find that by manual processes judiciously selected and properly taught, keeping the object in view in each case, we are able to assist men to acquire the necessary proficiency in elementary mathematics to pass in their respective arithmetic sets. I give you in advance of our 1898 yearbook, statistics on that point as follows:

"Out of an actual number of pupils—viz., fifty-eight in Group 1—we have to show graduation of thirty-four, which is fifty-eight per cent—that is, returned to the usual reformatory treatment as susceptible to the conditions governing their release.

"Our second group deals with the men who are assigned for the development of 'self-control,' which comprises by far our largest assignment—viz., two hundred pupils, made up of men who are intellectually bright in most cases, but this intellectuality runs riot, so that they are habitually breaking the demeanor regulations in the institution, and so must regularly be depressed in grade and their time of commitment correspondingly lengthened. We select for such men manual processes calculated to overcome, by the concentration of mind and regularity of muscular movement, the defective element in their nature.

"We are able to show out of an actual number of pupils—viz., one hundred and seven—twenty-three per cent as having been returned susceptible to the reformatory treatment. The moral influence of the manual training department is better observed from this group than any other. We note a particular instance of a man assigned to the manual training from the third grade (incorrigibles), who had committed almost all the crimes known to prison life. After

seven months of treatment in Group 2 he was graduated, and has for the past three months been filling one of the most honorable positions attainable in the walls of the prison, and is on a fair road to ultimate parole release.

"Our third division, Group 3, is one to which men are assigned for general 'mental quickening.' These pupils are nonsusceptible to our parole regulations. They have failed habitually in trade school, school of letters, and in some cases in demeanor markings. For this group, out of fifty-one actual pupils we can show twenty-nine per cent who have been sufficiently awakened mentally and physically to be susceptible to reformatory measures and conditions governing their parole release."

According to the philosophy of life which I have tried to present to you, evil is the absence of goodness, cold as opposed to heat, ignorance as contrasted with knowledge. It is a negative quality, and is to be fought as such—not something to be met and dealt with in itself, but something to be met and dealt with through its opposites. This was the view of Socrates, as it was later of Emerson and many other earnest souls. When carried out in any thoroughgoing way, it changes the whole aspect of things. Evil ceases to be the great central fact of philosophy and religion. Ahriman gives up his eternal conflict with Ormuzd. The dualism of the moral world becomes a strict monism; the one force of religion and morality is seen to be righteousness. The voice of religion directs itself less and less against evil—with only the good listening—and more and more to the realization of good. Morality concerns itself less with the things we must not do, and more with the things we must do. It gives us no longer the chill pictures of renunciation, of Anthony, and Simon Stylites, and the rest, living in caves and standing on pillars and doing other useless and foolish things, but glowing pictures of a positive life, warmed with wholesome human passion, and directed to wholesome human ends.

"Whom man delights in, God delights in, too."

And when this morality becomes touched with emotion, when this passion for the perfect life has mixed with it the sentiment of reverence for that goodly company of men and women who have passed toward the same ideal, has mixed with it a sublime faith in the unseen world, in the eternal things that are yet to be—a faith still more the child of knowledge and insight than of ignorance and superstition—then morality becomes religion and the human heart finds peace.

It is in this spirit that manual training accomplishes its moral work. It fights disease by setting free the forces that are health-giving. It conquers evil by the establishment of good. Such a moral betterment results from the betterment of the organic tissue of the

brain. If you will look at the faces of the children and the men and women published in such a record as the Elmira yearbook, first when they enter the institution, and then six months, twelve months, or eighteen months later, after they have felt the force of self-activity directed to some good end, you will be convinced, I am sure, that Ormuzd has been at work. And this intellectual betterment of the feeble-minded, and this straightening up of the morally oblique, are the result of definite reactions brought about in the brain tissue, in the tool itself; are organic, and as such are permanent and nonforfeitable.

What is true at all is true in the extreme. We have taken the extreme at the minus end of humanity; let us take now, somewhat more briefly, the extreme at the plus end. Never before, I think, was there such a keen interest as now in the popular and experimental study of the mind. Francis Galton opened the way in such books as Inquiries into Human Faculty and its Development, and Hereditary Genius. There is wide interest in the experimental work of psychologists. Even such morbid books as Lombroso's Man of Genius and Max Nordau's Degeneration attract thousands of readers, as well as the reply that Dr. Hirsch has made in Genius and Degeneration. These studies have concerned themselves quite as much with genius as with the normal and deficient. There is the reservation that the material for study is not so abundant. At Elwyn there are about one thousand deficient children. I think you could not find the same number of geniuses brought together at any one place, perhaps not even at Harvard. The results are, therefore, more meager and more uncertain. There has always been thought to be an intimate connection between genius and insanity, and, as you know, one extreme view is that genius is only a beneficent form of insanity. In most of our State institutions the insane and the deficient are put into the same general class, but in reality they represent the organic extremes. But while insanity and genius stand at the same end of mentality they are not, in spite of Lombroso and Nordau, to be in any way confounded. Both represent an excess of organization, a delicate bit of machinery capable of doing the finest work or of getting the most seriously out of repair. The very fact of genius seems to be made possible only by the disproportionate development of some part of the brain. If this take place and leave the other portions at least normally active, the result is beneficent, and there is no affiliation with insanity. But if such an overdevelopment take place at the expense of neighboring centers, sooner or later there comes an occultation of some of the other powers, and insanity results. In a rough way this explains, I think, the relation between genius and insanity. Both are an overbalance. They have this in

common. But genius is an overbalance between the special gift and normal powers, while insanity is an overbalance between high organization on the one hand and deficiency on the other. The examination of brain power shows it to be dependent upon two factors, size and quality. A large brain, full of gray and white matter of low organization, may belong to an intellectual infant. A small brain, composed of highly organized matter, may be the tool of an intellectual giant. In a general way intellectual power seems to be physiologically a function of brain surface. The heightening of organization and increase of surface do not come about as the result of any and every sort of activity. The repetition of an act creates a path of least resistance, until at last seemingly difficult acts become far easier than simple ones that are new and untried. If the repetition proceed far enough, the mental reactions cease almost entirely, and we have automatic action. It is this consideration that makes us spend so much time upon the models used in sloyd and manual training. It is very important to have them properly graded, so that succeeding exercises shall present increasing difficulties. This constitutes a vital difference between industrial and educational training. Industrial work is only practicable where skill is so far automatic as to be utilized with economy of time. But when this takes place, education ends. And this is one of the great reasons why I so warmly disparage industrialism as an ideal of life. It produces, and must produce, fragments of men and women, automatic machines, instead of complete men and women open and ever open to new influences. I mean some time to develop this thought, and to show that in our choice of vocations, even intellectual, and the tenacity with which we stick to them, we practically put an end to our own growth, and rob ourselves of the most complete manhood and womanhood. And I mean to recommend that we make life itself educational, and that we undertake a rotation of related vocations just as our farmers do a rotation of crops. They could undoubtedly hoe corn more economically if they did nothing else, but the thing is that the ground would not stand it, and the crops would get smaller and smaller while the hoeing was growing more and more efficient. We can work more economically by sticking to our last, but the thing is that the spirit will not stand it, and the good that flows out of our shoemaking grows less and less, even though our rate increases.

There is a striking parallel between these reactions and the reactions that follow upon pain and pleasure. Those of you who have experienced grief and suffering know that the terrible thing about it is its monotony, its dull monotony, a monotony so terrible that if it continues too long it leads to despair and to the paralysis of feeling

and action and thought. But the main characteristic of joy is its diversity, the wide range of its expression. To the lover—I am told—earth and air, sea and sky, reflect his happiness, and out of the quickening power of the greater sentiment have come the greater works. To fancied pain we owe the morbid and sickly pictures of our literature, but to satisfied love such delights as the Spring Symphony.

And so I believe in happiness, not alone as the only defensible ethical end, but also I believe in it organically, educationally, as an element essential to the best educational training, for out of it spring life and performance, and the fullness of life. In an age of too great pain and suffering, we do not want the gospel of endurance. We want the gospel of joy and health, the gospel of *good* tidings. It seems to me a ghastly thing, psychologically, morally, emotionally, to offer the deadening ideals of renunciation in place of the quickening ideals of a noble self-realization; in place of life, paltry excuses, buried talents wrapped up in the napkins of resignation.

But to return to our genius, who has been wondering, I am afraid, what was to become of him. I have wanted to point out that monotony and unhappiness do not make for that brain structure which is the tool of genius. In the genius we have the other extreme, a highly sensitive and highly organized brain tissue, and along with this complete organism, as an essential part of it, a marvelous power of movement. I doubt if there is such a thing as dormant genius. It is bound to express itself, to do something. This expression has to be in terms of the outer world, has to be through the medium of the bodily faculties. Genius means, in fact, the seeing eye, the feeling hand, the hearing ear. It means infinite patience exerted through action. Genius expresses itself through art, whether it be the art of action, in engineering, exploration, statesmanship, or the art of creative work, in painting, sculpture, architecture, music, and literature. This requires a high degree of activity on the part of the senses, and a very true and sound activity. Even the most immaterial of these expression forms of genius, literature, is dependent for its triumphs very largely upon the accurate report of the senses. Think of the alertness and the power of observation shown by Homer and Shakespeare. Nature has by no one been so accurately reported as by the poet and the *littérateur*. Do you remember that touching little scene in Cranford, where the old ladies go to see the yeoman farmer, and he shows them his garden, and tells them that he never knew the ash bud was black until it was pointed out to him by a young poet, a certain Mr. Tennyson? And here in our midst, Thoreau and Burroughs and John Muir have brought Nature nearer home than all the microscopes imported from Germany.

In most of the expression forms of genius the senses play an all-important part. They must not only report accurately, they must operate together accurately. Think of the part played by the eye, the hand, the ear in the fine arts of painting, sculpture, architecture, music. These artists of whatever field, these men of genius, can do things that other men can not, things finer, truer, quicker.

The biography of genius makes it very clear that along with the highly sensitive brain organization goes a power of co-ordinated bodily movement not found in those less favored of the gods, just as a study of the deficient classes makes it very clear that along with a poorly developed brain tissue goes a pitiful lack of co-ordination in the bodily movement.

One can not, I think, look these results squarely in the face—results from both extremes of the intellectual scale—without accepting the middle ground as well. A well-developed brain organism is always accompanied by well-developed sense powers, and the senses can not be well developed without a corresponding increase of brain power. It is then both an actual and a possible result of manual training that through the cultivation of the sense faculties comes an increased power of the organism; and through this one comes into more complete control and possession of one's self—becomes, in fact, a more evolved and more moral being.

I would not claim too much for manual training. It does not pretend to make deficient boys clever, or average boys geniuses; but it does make deficient boys less deficient, and average boys more clever.

From this renovated self spring enlarged ideas of one's relations to other individuals. Manual training fosters individualism, and I have long suspected this to be the only *social* creed, despite the taunting cry of the opposition, "Every man for himself." Increased personality, deepened individuality, mean increased and deepened respect for the personality and individuality of others. I find as an actual result of manual training that one is less and less willing to enjoy things at the expense of others or to be waited on by others; less willing, too, to serve others in ways that are not worthy; quite willing to show others how to serve themselves. Increase of personal power means increase of self-poise and self-sufficiency. It does not, however, mean a smaller sympathy. On the contrary, the more evolved imagination makes possible a larger sympathy. Mr. Fiske has successfully shown that much of the cruelty and inhumanity of the world is due to lack of imagination, and inability to picture another's point of view or to put one's self in another's place. But I want you to mark especially that the quality of the sympathy fostered by manual training, or by

individualism, whichever you choose to call it, is somewhat different from the current ideal of sympathy. It is sympathy with joy and strength rather than with pain and defeat. In this it is somewhat stoical. I do not mean that individualism is indifferent to the woe of the world, or that it is insensible to the too real *Weltschmerz*, but it is more given to set to work to cure the woe than to drop a tear over it. A thoroughgoing individualist—and I detect in manual training a tendency to produce these—does not ask sympathy for himself in suffering. If it is preventable, as much of the suffering caused by illness is, he finds better consolation in the attempt to lead a saner life. If it is not preventable, if it is suffering that in the present order of things must be, such as the loss of a dear friend by death, the coming on of old age, the gradual decay of one's powers—and these are real tragedies—he would endure these things in silence, and ask rather that you rejoice with him over the good that is universal and eternal; and what he would ask for himself he would naturally give to others—comradeship and broad sympathy, but seldom tears.

There is another result of manual training which I may perhaps only hint at, but which I believe to be very real. It is the social conscience which springs out of individualism. Do you know that in this free land of ours we have millions of people who are only nominally free? The suffrage does not make one free, and the women, I am sorry to say, have not even the suffrage. There are millions of people, domestic servants, laborers of the field and mine, the factory and store, who are, as Helen Campbell has well called them, the prisoners of poverty. And these men and women, and too often children, are leading bare and stunted lives that no amount of well-being on the part of the upper classes and no amount of public achievement can socially defend or justify. A great blot upon the glorious civilization of Greece was that it was built up on human slavery. Our own civilization rests upon foundations too similar. We have a small privileged class, cultured, or pleasure-seeking, or both, living upon the Grecian foundation, upon the labor of others. Through interest, rent, taxes, royalties, land tenures, and monopolies of many names, these people are removed from productive labor. But they must all be fed and clothed and housed, and this luxuriously. Do you realize how this is done; what it signifies in human flesh and blood? It means, my friends, that some one else is doing it for them, that for each man and woman and child living in idleness, men and women and children, with needs as exigent, and capabilities ultimately as great, and hearts as hungry, are getting less than human allowance. I should be sorry to make this picture more pitiful than it is, or come anywhere near the bounda-

ries of the melodramatic, but I can not walk the streets of our great cities, I can not turn north, or south, or east, or west, without confronting faces and figures that speak so hungrily of unappeased human need, that tell me plainer than any words could ever do that we are living in an age of low social ideals, that the social sensitiveness and the social conscience have yet to be aroused. I used to lay comfort to my heart by contemplating those great and glorious economic laws of supply and demand, production and consumption, the division of labor, and the other gods of wood and stone and brass that society has reared its altars to. I fancied that it was the function of the more fortunate classes to think for the rest and to lead. But it was an impious thought. One could as logically defend the most complete priestcraft. Why should men pray to God if this company of better-versed supplicants stand ready to pray for them?

It was this thought of what I myself might become, this picture of the complete man that might be aroused in me, that awakened me to the needs and the capabilities and the hunger of others. And I count it as one of the most precious of the actual results of manual training that in developing a most intense individuality in those who come under its influence, it fosters no less surely a sincere respect for the sacredness and individuality of others. I can not say that manual training has developed any specific social creed. But it has done this: it has created a profound and rational discontent with the present social *régime*, and has prompted a practical desire to set men free. It is not revolutionary. It sees in the present enginery of society a means for its liberation. In time this thought will flower into beneficent action.

The process of evolution is the rationalization of the world. With the passing of the centuries what is capricious, grotesque, impossible, slowly falls away, and there emerges a world of rationality and of order. The transforming power has been the continuous growth of the idea of causation. As this power lays firmer and firmer hold upon the minds of men, they become as gods, knowing good and evil, and pressing nearer and nearer to the life that is immortal. One can not live in such an unfolding world, revealed to him through the experiences of his own inner life, without feeling anew the sentiment of wonder and of worship, without possessing a sublime faith in the things that are and are to be. It is not a specific creed, but in it abides the essence of all religion, and in it one's relations to Nature and to the Supreme Intelligence are to be sought and found.

It has been the custom of many of the manual training schools to preserve a careful record of their graduates, and you will find in

these records the most practical testimony available of the actual results of manual training. Dr. Woodward, the director of the St. Louis school, and one of the fathers of manual training in America, has given many individual records in his two books, The Manual Training School and Manual Training, especially in the former. The results quoted are mainly industrial, but they are nevertheless of high interest from an educational point of view. Some of the schools publish records of their graduates in their current yearbooks. I found, for example, in my own school that one third of the graduates were in universities and other institutions of higher learning; that one third were engaged in technical work opened to them by the special training of the school; and that the remaining third had gone into trade, had taken miscellaneous posts, or were still unsettled as to a career. The latter number was always small, and there were particular moments when less than one per cent of them were unoccupied. The records made by the graduates at college have been excellent. Three of the Philadelphia boys have held fellowships at Harvard, one in philosophy and two on the Hector Tyndale foundation in physics. It was noticeable, as I mentioned before, that the colored boys seldom graduated. They worked under many disadvantages of poverty, and later of race prejudice outside the school, and I should therefore not wish to draw any unfavorable conclusions from their failures. Those of mixed blood, especially Indian or West Indian, were sometimes very clever, and became quite skillful; but the full-blooded Africans were less successful, and I have come to think that they ought to be taught apart and at less speed.

It was also noticeable that the Jewish children were quite clumsy with their hands. So much was this the case that the instructors in the manual departments came to make allowance and to set a different standard for their work. It is quite explainable, I think, since the Jews as a people have been forced by circumstances into commerce and banking, and have been for centuries practically excluded from manual occupations. I mention it as an interesting racial result, and not at all by way of discouragement. I feel that the Jewish people would be very wise to persevere in their present brave attempt at manual development. Nor was the best manual work always done by the children of mechanics. Often it was done by the sons of musicians and other professional people, and even by the sons of business men. It would, I think, be more to the point to inquire into heredity on the mother's side, since boys more frequently resemble their mothers, but this is less practicable.

The Chicago Manual Training School, the oldest independent manual training school in America, publishes an interesting summary of the occupations of its graduates. Out of a total of 568, 158

are in college or higher schools, 66 are in manufacturing establishments, 48 are engineers, 52 are superintendents and managers, 33 are lawyers, teachers, or architects, 133 are in trade, and the rest at miscellaneous work, unknown, or dead.

The catalogue of the Philadelphia Central School contains the following paragraph:

"An examination of the records of the six hundred and fifty graduates reveals the fact that the claims made by the school as to its practical value in gaining a livelihood are fully substantiated—about seventy per cent being engaged in those pursuits in which a high order of intelligence as well as skill of hand are required. Already a large number occupy positions of trust and responsibility—as superintendents, managers, foremen, etc. That the school fosters a desire for higher education is shown in the fact that about twenty-five per cent of the graduates are students in colleges, universities, or technical schools."

These actual results are much the same in every manual training school in the land. They show increased power on the part of the graduates, and a practical ability to take care of themselves. And yet in quoting these results I am reminded of the little girl who said, when her drawings were highly praised, that they were not her best. She was urged so warmly to show the rest that she finally explained that her best drawings had not yet been made. These actual results of manual training are good, practical results and are most encouraging, but the best results of which it is capable have not yet been brought out. We stand only on the threshold. But in these large possible results I believe just as firmly, and I do so because I believe in cause and effect, believe that what you sow you reap, that beneficent causes are surely followed by beneficent effects.

MR. DEWAR has succeeded in liquefying hydrogen at a temperature of — 205° C., under a pressure of one hundred and eighty atmospheres, obtaining the liquid in considerable quantities. Previous to his experiment, M. Cailletet had reduced hydrogen to the condition of a fog, and another experimenter had obtained a few drops of the liquid, but had never been able to perceive a meniscus separating the liquid from the gas. In Mr. Dewar's experiment the liquid flowed and was collected in specially constructed vessels, to the amount of fifty cubic centimetres. Liquid hydrogen is colorless and very transparent, with a considerable index of refraction and a density superior to the theoretical value. It presented no absorption spectrum, and condensed air, which at the temperature of the experiment passed into the solid state, and fell as a snow to the bottom of the liquid. Wadding dipped in the liquid and exposed to a flame burned without deflagration. Placing a tube filled with helium gas in the liquid, Mr. Dewar obtained liquid helium.

THE CASE MOTHS.

By MARGARET T. D. BADENOCH.

IT seems an incontrovertible fact in natural history that there is not a single character which has been used to distinguish any group of considerable extent from which some one or more of the members thereof may not depart. In that great division of the animal kingdom characterized by the possession of articulated limbs, many species are met which are entirely wanting in those organs, and, similarly, the secondary division of the *Annulosa*, marked by the presence of wings in the final state—the *Ptilota* of Aristotle—contains species that, throughout life, never acquire instruments of flight. Of wingless insects, indeed, examples might be drawn from most of the orders, and in the majority of cases the females only are thus deprived. Rarely, however, both the great characteristics are absent. Yet certain moths do not possess articulated feet in the wingless state.

Consequently, if we took into consideration merely the adults of these females, this group must be regarded as among the most degraded instances of apiropodous insects. But such a conclusion can not be maintained, as shown by an examination of the early stages of the moths, for these, we find, exhibit as high an amount of organization as those of any of the other insects appertaining to the order. The truth is, these females have become degenerate—very different from the creatures they once were. Their peculiarity consists in this, that whereas, as a whole, winged insects always undergo a gradual evolution of structure, by which ultimately legs and wings are developed, these individuals gradually lose their powers of evolution, and not only this, but suffer a process of deterioration, by which the limbs which they at first possess diminish, and at length dwindle altogether away, until the animal becomes a mere short, inert vermiform bag, having not only no distinct trace of legs and wings, but also the sense-organs, the antennæ, and the organs of the mouth are almost or entirely obliterated, and even the articulated condition of the body has almost disappeared. In these extreme forms it is hardly possible for the degeneration of the female to proceed further, and in all, doubtless, the change has occupied an immense period.

Than these extraordinary moths, familiar to German entomologists under the name of *Sackträgers*, perhaps no more curious and interesting examples occur among the whole of the insect races; certainly in structure of the female, and in habit, they are the strangest and most abnormal of all *Lepidoptera*. They belong to the *Psychidæ*,

a portion of the remarkable silk-spinning family of the *Bombycidæ*, but offer many points distinct in themselves, which entitle them to rank, as recent lepidopterists agree, as a separate and well-defined tribe.

Their geographical distribution is extensive, since they are found in Europe, in North and South America, the West Indies and Mexico, in northern India and Ceylon, in China, the South Sea Isles, and Australia, being most abundant in subtropical regions. Wonderfully few species are described as natives of the United States, while in California, unfortunately, three have been discovered solely in the larval state, the more mature conditions of the species as yet eluding detection. But there, as in various other parts of the globe, probably greater numbers await the industry of observers.

Among English-speaking folk, the common appellations for the moths originate in the same circumstance as the popular term in Germany — house-builders, sack-bearers, basket-carriers, basket-worms, case moths; by these names they pass in England, America, and Australia, on account of the singular habitations or sacks they weave for the well-being of the caterpillars in the early stages of their growth. Through the whole of their larval life they carry the protecting structure about with them; and as regards the apterous female, she never leaves this home in which she dwelt while in larva—one of the oddest incidents in this odd economy—but reaching maturity, and bringing forth her young, dies at last, without once quitting her self-constructed prison. She deposits her ova, an immense number, within the body of the case, closely enveloped in some species in a short silky down, and almost as soon as hatched the larvæ force their way out of the puparium which had served for the defense of the eggs, deserting their early abode, and going into the world to follow independent lives. Escaping in crowds from the lower end of the tube, to some twig or leaf, they immediately commence to prepare for themselves each a separate case, arranged in every respect as the larger ones, even before they have taken food.

Particles of wood or bark, leaves, sticks, straws, lichens, mosses, and other vegetable substances form, among the different species, the outer covering or decorative fortification of the house; the interior is lined with soft silk, and interwoven silky threads likewise bind together the external fragments. In the building materials chosen, and their arrangement, *Metura elongata* is a most interesting architect. Strengthening the large elongate ovate bag of silk, and worked into it, irregularly, numerous rows of short sticks appear, rather distantly separated, and about half an inch long, generally speaking, but toward the lower end there are usually several

sticks from one to four inches long, in the center of which the lower end of the silken bag protrudes, free from sticks and very flexible; it has a charming silky softness, and is of a gray, ash, or mouse color; of this beautiful tissue the upper or head extremity is also composed, forming a tube half an inch wide.

As a larva grows, needing more accommodation, it splits the habitation at the sides, weaving into the opening portions of the vegetable substances selected, and adding to the exterior fresh pieces of stick, straw, or leaves, as it requires. So with Saunders's case moth, when any accident happens to the nest, the caterpillar, with incredible expedition, repairs the damage received, employing the same silky stuff to fill up the hole, and with a nicety so perfect that the severest scrutiny can not detect what was the extent of the injury.

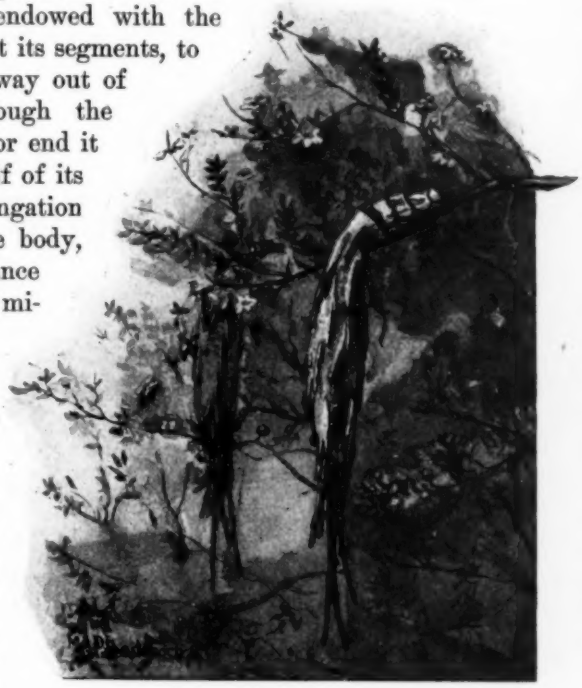
Under the protection, then, of the substantial and somewhat formidable case the larva lives. At each end there is an opening, and through the anterior one it emerges to feed and change its position. Commonly it only protrudes the head and the first three or four segments of the body, or sufficient to use its six true legs for locomotion when feeding; and if wishful to remain quiet, it usually takes the precaution of fastening a portion of the edge of the aperture by fibers of silk temporarily to the branch upon which it is, that, if alarmed, it can suddenly recede completely into the case, very rapidly drawing in the flexible part after it, by means of its mandibles and fore legs, and contracting the aperture, so as to exclude all enemies; thus hid, it stays in security, suspended only by a few threads. Were the nature of the hanging, tight-closed, strong, tough sack unknown, it would never be suspected of containing an active, voracious larva. Exceedingly wary and timid are these insects in retreating at the approach of danger. On a desire for removal the suspending threads are bitten off close to the case.

As long as the caterpillar is small, and the house of no great weight, it is borne nearly erect; but soon, as a rule, the incumbent mass lies flat, owing to increased weight, and is dragged along in that attitude. The abdominal and anal legs of the larva are furnished with a series of small points or hooks, with which it moves in the tube, laying hold of the interior of the lining, to which it can adhere with great pertinacity; so firm the hold retained, it is impossible to remove the creature without injury.

Having attained full growth, and being about to change to pupa, the larva of *Metura Saundersii* firmly fixes itself, by means of silken fibers spun for the purpose, to a branch or trunk of a tree, or

paling, drawing together and permanently closing the head opening. It reverses its position in the case, so that the head is where the tail used to be—pointed toward the posterior or unattached end —and envelops itself in a soft silken cocoon of a yellowish color; allowing itself to hang perpendicularly, head downward, it awaits the pupal sleep.

From the facts just stated it need hardly be said that, when the time arrives, the perfect insect emerges from the posterior portion of the tube. At this particular time the male pupa becomes endowed with the power of stretching out its segments, to enable it to work its way out of the extremity. Through the opening of the posterior end it pushes the anterior half of its length, by a slight elongation and contraction of the body, which, with the assistance of a transverse series of minute sharp spines or hooks, directed backward, on some of the segments, is in this way forced out head foremost, in like manner as the pupæ of the goat moths and the large swifts are made to emerge from timber and the earth when the moth is ready to escape. The pupæ are prevented from being thrust entirely out of the case by two strong anal hooks. After the issue of the imago the segments remain in their stretched-out condition; cases having belonged to males are often seen with the empty pupa skin sticking rather more than half out of the lower aperture, hanging head downward, as left by the moth.



The males of these moths are swift fliers, of extraordinary activity, dashing themselves wildly, almost to pieces, among the branches of the trees. A fiery little creature has no sooner arisen from his pupal slumber than he begins his violent fluttering, and as the wings are delicate in structure, in many instances nearly transparent, his beauty has generally disappeared before the entomologist can secure him; therefore specimens in good order are rare in collections.

With slight exception, we find no homogeneousness in the perfect state of the insects of this group, but much variation of form presented by the different species. The general shape of the body varies from one greatly elongated, as in *Metura elongata*, to a short and robust as well as to a short and slender form. In like manner the wings vary from a long, narrow, and sharp-pointed wing, as in *Metura*, to those of short, broad, and ample proportions; and, again, may either be densely squamose, or colorless, of beautiful hyaline texture, almost or completely destitute of scales or hairs. The antennæ may be deeply pectinated only at the base, in others they are feathered to the tip, and in the number of joints offer striking variations. But the males of nearly all *Psychidæ* are characterized by a uniform dull dark color, of a brown or gray tint; there is an almost total absence of bright color or of pattern. Yet these moths are in nearly all cases day-flying. Probably the beauty of the males disappears when the females become degenerate, and the conditions which produced it are then at an end.

The larval cases of these moths are among the "common objects" in Australia, meeting the eye everywhere suspended to trees and shrubs, such as the different kinds of *Leptospernum*, *Melaleuca*, etc., by their anterior end, and swinging loose otherwise. When unusually abundant, so as to look like a good crop of some seed or fruit, the pendent berths are particularly conspicuous, and attract the attention of the least curious of mortals. The most striking examples of the group belong to *Metura Saundersii*, whose cases are sometimes over five inches long; those of the male are one third smaller.

Considering this abundance, the insects are singularly rare in the moth state; not one case in a hundred will be found to produce a moth, owing partly to the destructive effects of attacks on the larvæ of ichneumonideous and dipterous parasites. From the same cause, nothing is harder, nay, more nearly impossible, than to rear these creatures in confinement; the caterpillars of a species may be collected persistently for years, and watched with incessant care, and yet never reach the perfect stage; hence there are already imperfectly known species of which the more mature conditions await discovery; and when success does attend our efforts at protection, many examples are probably observed of the depredations of the insidious parasites. Not that failure to attain perfection is always due to infesta-

tion of parasitic insects, as undoubtedly the somewhat ponderous houses of the larvæ render them to a high degree impervious to the onslaughts of insect enemies; the cause of death must be looked for elsewhere. Death usually occurs after the larva has undergone metamorphosis, the pupa gradually shriveling up after assuming its proper form, nor can anything be done, apparently, to avert the calamity.

To return to the case moth's metamorphoses. The female insect, as we have seen, unlike the male, is destined never to desert the larval home. For her no hour of emergence ever comes. When the pupa has slept the appointed time, the unwieldy and almost motionless moth feels little of the movement of oncoming life then experienced by her lithe and lively partner; the animal, still resident within the habitaculum formed by the larva, splits asunder the pupa skin, and her transformations are complete; in some, at least, of the species the female imago is continually inclosed in the pupa case. Here, therefore, we have an insect which in its adult state is forever excluded from the light, and never even beholds its mate.

Having filled the bottom of their puparium with their ova, packed in the down rubbed from their own body, these females do not long survive. The moth is then literally nothing but thin skin. Reduced to a shriveled, dried, and scarcely animated morsel of this matter, she either presses herself through the opening of the case or, exhausted, the last feeble flicker of life burned out, expires within.

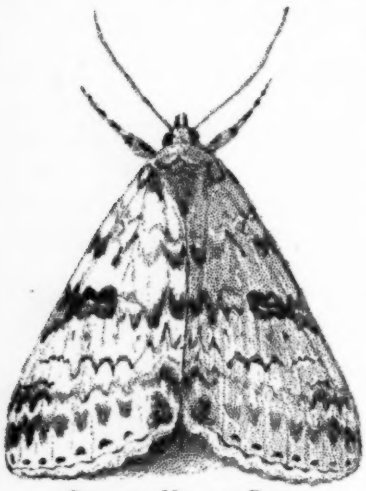
A GAME OF HIDE AND SEEK.

By CLARENCE MOORES WEED.

NOTHING illustrates more vividly the change which has taken place during the present century in the attitude of naturalists toward the objects of their study than the colors of plants and animals. To the dried-specimen systematist of a hundred years ago color was an immutable factor in Nature. The delicate beauty of the butterfly, the iridescent hues of the paradise bird, the tawny stripes of the tiger, the somber shades of the reptile, the whiteness of the lily and the redness of the rose—these and the myriad other color phases in the living world were believed to exist now as the Creator designed them a few thousand years ago. To the naturalist they were chiefly valuable in enabling him to separate species from species in dreary Latin tomes. To the theologian they served to show the goodness of God in adorning man's passing abode. To the artist beauty was its own excuse for being.

But there were not wanting interpreters of Nature who saw that

in many cases colors were useful to the organisms possessing them. Sprengel expressed his belief that the colors of flowers served to attract insects which aided in the fertilization of the seeds. Other observers showed that dull hues in animals might assist a persecuted species to escape from enemies, or a persecuting species to steal upon prey. Such views were at once utilized by the promoters of the celebrated "argument from design," who contended that these creatures were so made when created, the useful coloring being conclusive evidence of a designing intelligence on the part of the Creator. In those days all paths in the fields of science led to the domains of theology, where it was unsafe to wander without the guidance of a keeper appointed by the church. To this individual puzzling problems were easy of solution: "God intended it so, and who shall dare to question the actions of Infinity?" Natural phenomena were given supernatural explanations which were accepted in a way that seems incredible to us to-day. But gradually the law of parsimony in logic—the law which in this case directed that when a phenomenon can be explained in natural terms, we must not appeal to supernatural ones—became accepted, and reasons that had long held good were rejected as worthless. The hold of dogmatism and priestcraft upon science gradually relaxed as the church meddled less in secular matters and religion became an affair of the heart rather than of the intellect.



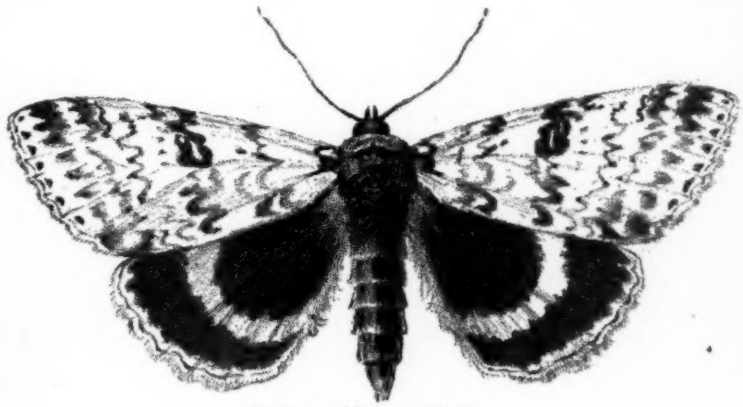
CATOCALA MOTH AT REST.

It is one of the triumphs of biology—the youngest of sciences—that she has already given an adequate explanation for the existence of most of the phases of animate color. We all now know that the colors of flowers exist, as Sprengel believed, to attract insects, and that insects are attracted to insure cross-fertilization—a fact of which Sprengel was not aware. All the world is familiar with accounts of mimicry—"the imposture of Nature"—as well as of protective and aggressive resemblance. Nearly every one has seen pictures of the kallima insect, which when in motion is a gaudy butterfly, and at rest becomes a dry and withered leaf; or of the various leaf insects and stick insects of the tropics. Many of us have seen in imagination the puff adder which Professor Drummond did not sit upon in the wilds of Africa, or have watched with Forbes the bird's-dropping

mimicking spider of the eastern archipelago. We have also followed Bates and Wallace along the Amazon, or Belt in the wilds of Nicaragua, as they studied the tropical butterflies which mimic each other so strangely.

The fact that most published accounts of mimicry and protective resemblance deal with animals of tropical countries has led to a general impression that to observe these curious color phenomena one must travel to out-of-the-way places; that the creatures about us are commonplace and uninteresting. But to the seeing eye and the attentive mind there are as many facts of interest in a stroll through northern woods as through the Everglades. Richard Jeffries and John Burroughs found in England and New York most interesting phases of tropical life, and had besides the exhaustless treasures of their temperate out-of-doors to draw upon. The tropics are full of strangeness to northern eyes, and possess many phases of life that seem wonderful to unaccustomed minds. But the luxuriance of vegetable life is almost oppressive; it is always in full glory; one does not see the bursting buds and the greening leaves because the full foliage overshadows all else.

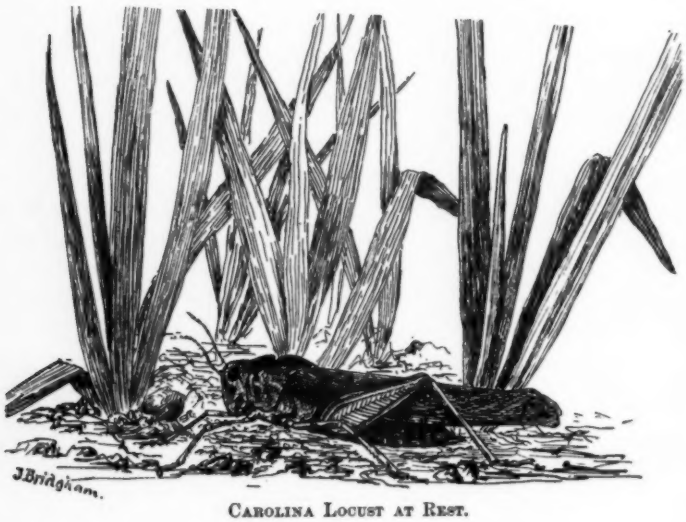
The animals of the north show numberless color phases of interest. One of the most curious of these is exhibited by several families of insects in which the outer wings are protectively colored in dull



CATOCALA MOTH IN FLIGHT.

hues and the under wings brightly colored. For example, there are many species of moths belonging to the genus *Catocala* found throughout the United States. These are insects of good size, the larger ones measuring three inches in expanse of wings, and the majority of them being at least two thirds that size. Most of them live during the day on the bark of trees, with their front wings folded together over the back. The colors and markings of these wings, as

well as of the rest of the exposed portions of the body, are such as to assimilate closely with the bark of the tree upon which the insect rests. In such a situation it requires a sharp eye to detect the presence of the moth, which, unless disturbed, flies only at night, remaining all day exposed to the attacks of many enemies. Probably



CAROLINA LOCUST AT REST.

the most important of these are the birds, especially species like the woodpeckers, which are constantly exploring all portions of the trunks of trees.

The chief beauty of these *Catocalas* as they are seen spread out in the museum cabinet lies in the fact that the hind wings, which, when the moth is at rest in life, are concealed by the front ones, are brightly colored in contrasting hues of black, red, and white in various brilliant combinations. These colors, in connection with the soft and blended tones of the front wings, make a very handsome insect.

To explain these colors many suggestions have been made. The protective hues of the upper wings are easy to account for by accepted biological theories, but the bright colors of the under wings have presented more difficulties. Some biologists have supposed that the latter were without special significance, being produced by the tendencies of the insect to bright colors—the tendency not being kept down by the eliminating factors which would operate in the case of exposed portions of the body. On this principle Mr. Beddard would "expect that bright coloration would be the rule rather than the exception among nocturnal insects, for, however bright and varied, the colors would be invisible at night and could do their pos-

sessors no harm or good," an ingenuous assumption characteristic of many of the pages of that naturalist's recent book, in which the attempt to keep on both sides of the Darwinistic fence has left the author very much astraddle. Another English naturalist, Professor Poulton, has suggested that the bright under wings lead the pursuing bird to catch the insect by them, the wing membrane giving way without serious injury to the moth. But this seems to me a strained and inadequate explanation, much less satisfactory than the one afforded by the suggestion of another celebrated English entomologist, Lord Walsingham, who in a presidential address before the Entomological Society of London delivered the following passages:

"My attention was lately drawn to a passage in Herbert Spencer's Essay on the Morals of Trade. He writes: 'As when tasting different foods or wines the palate is disabled by something strongly flavored from appreciating the more delicate flavor of another thing afterward taken, so with the other organs of sense a temporary disability follows an excessive stimulation. This holds not only with the eyes in judging of colors, but also with the fingers in judging of texture.'

"Here I think we have an explanation of the principle on which protection is undoubtedly afforded to certain insects by the possession of bright coloring on such parts of their wings or bodies as can be instantly covered and concealed at will. It is an undoubted fact, and one which must have been observed by nearly all collectors of insects abroad, and perhaps also in our own country, that it is more easy to follow with the eye the rapid movements of a more conspicuous insect soberly and uniformly colored than those of an insect capable of changing in an instant the appearance it presents. The eye, having once fixed itself upon an object of a certain form and color, conveys to the mind a corresponding impression, and, if that impression is suddenly found to be unreliable, the instruction which the mind conveys to the eye becomes also unreliable, and the rapidity with which the impression and consequent instruction can be changed can not always compete successfully with the rapid transformation effected by the insect in its effort to escape."

CAROLINA LOCUST IN FLIGHT.

Lord Walsingham goes on to suggest that this intermittent display of bright coloring probably has as confusing an effect upon birds and other predaceous vertebrates as upon man; and that on this hypothesis such colors can be more satisfactorily accounted for than upon any other yet suggested.

This explanation is easy to understand and gives renewed emphasis to the oft-repeated statement that nothing in Nature is without significance. In the case of the *Catocala* moths one readily perceives that when driven to flight by a woodpecker or other bark-searching bird a moth which shows during a rapid irregular flight bright colors, and then alights, hiding the colors and instantly assuming entirely different hues, blending with the surroundings, would stand a better chance of escaping from a pursuing bird than a moth which had no bright colors with which to confuse the bird and prevent its seeing the place where the insect alights.

These insects are excellent illustrations of the combined action of the various forces which Darwin classed together under the term "natural selection." The factors involved are three—multiplication, variation, elimination. In nearly all organisms more young are produced than can mature. In these young there are infinite variations in all directions. Some of these variations fit the individuals possessing them better to the conditions of life than variations in other directions. Consequently, the possessors of the latter will be eliminated in the struggle for existence and the former will escape elimination, and mature to reproduce. Their young will in part at least inherit the favorable variations, and thus have an advantage which will lead to their reproduction. Thus there is an ever-increasing tendency to a more perfect adaptation to environment.

Coral-winged Locust in Flight.

On the rocky hills and sandy plains of New England there are several species of grasshoppers or locusts that also illustrate these principles. If you walk along a strip of sandy land in summer, you start to flight certain locusts which soon alight, and when searched for will be found closely to assimilate in color the sand upon which they rest. On a neighboring granite-ribbed hill you will find few if any of this species of locust, but instead there occur two or three

quite different species, which when at rest closely resemble the lichen-covered rocks. This resemblance is very striking, and is found in all stages of the insect's existence. If now you go to a lowland meadow, still another color phase will be found to prevail—the green grass is swarming with the so-called "long-horned" grasshoppers, which are green throughout, with linear bodies and long, slender legs and antennæ.

Each of these three groups of insects is adapted to its particular habitat. All are constantly persecuted by birds, and have been so persecuted for unnumbered ages in the past. In every generation the individuals have varied, some toward a closer resemblance to environment, others in an opposite direction. The more conspicuous insects have been constantly taken, and the least conspicuous as constantly left to reproduce. Were the three groups to change places to-day, the green grasshoppers from the meadows going to sandy surfaces, the sand-colored locusts going to rocky hills, and the "mossbacks" from the hills to the lowland meadows, each would become conspicuous, and the birds would have such a feast as is seldom spread before them.

The species living on sand and rocks are often "flushed" by birds. Those which flew but a few feet would be likely to be captured by the pursuing bird; those which flew farther would stand a better chance of escaping. Similarly, those which flew slowly and in a straight line would be more likely to be caught than those which flew rapidly and took a zigzag course. As a consequence of the selection thus brought about through the elimination of those which flew slowly along the straight and narrow way that led to death, you will find that most locusts living in exposed situations when startled fly some distance in a rapid, zigzag manner.

But still another element of safety has been introduced by some species of these locusts through the adoption of the color tactics of the *Catocala* moths. The under wings of the common Carolina locust—the species most abundant along the highway—are black, bordered with yellowish white. The base of the hind wings of a related species living on the Western plains is bluish, while in the large coral-winged locust of the Eastern States the hind wings are red, bordered with black. In nearly all of the species of these locusts frequenting open localities where they are liable to disturbance by birds or other animals, the hind wings exhibit contrasting colors in flight. Most of them also fly in a zigzag line, and alight in a most erratic manner. Many times I have had difficulty in determining the exact landfall of one of these peculiar creatures, and I believe Lord Walsingham's suggestion is well exemplified in them.

CHRISTIANIZED MEGALITHIC MONUMENTS.

By M. ADRIEN DE MORTILLET.

WE possess now more precise and more scientific data concerning megalithic monuments than those which we had before they were studied and explored methodically. We know that the dolmens, whether still covered with a tumulus or stripped of the envelope of stone or earth which formerly covered them, are simply sepulchral caverns, that they were built in the polished stone age, and that that mode of burial was abandoned at the beginning of the bronze age. While we do not know so exactly for what purpose the menhirs were erected, we have every reason to believe that they were for the most part contemporary with the dolmens. The great antiquity of these rude constructions—monoliths sometimes of imposing dimensions—seems to be confirmed by their being often the subject of very ancient and deep-rooted legends, which have been preserved through ages without material alterations. The recollection of the real purpose of these stones was lost at the beginning of the Christian era, and probably a long time before. Marvelous tales then began to be current, assuming to explain their existence, form, and arrangement. The habit gradually was developed of resorting to them to perform curious rites which have continued or are remembered to the present day. A considerable number of them were held in such veneration that they became clothed in a sort of sacred character, of which it has not always been possible to divest them.

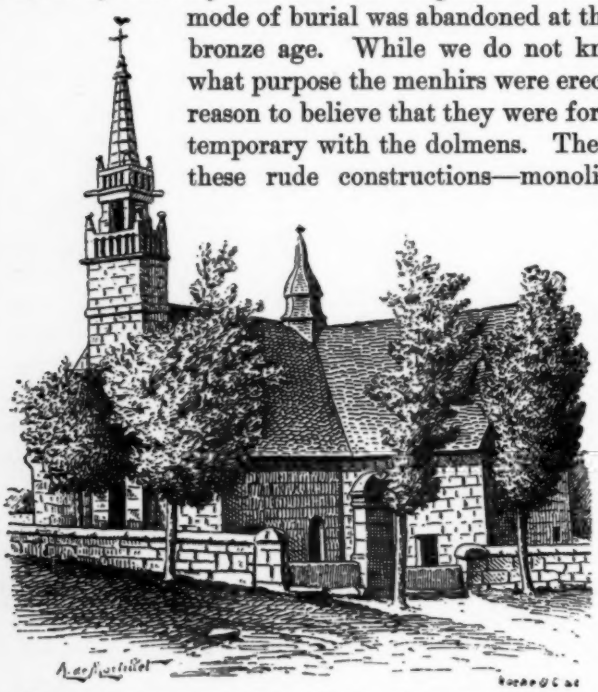


FIG. 1.—CHURCH OF THE SEVEN SAINTS. From the southwest.

When Christianity was introduced into France, it had of course to contend against the old beliefs. A bitter war was declared against everything that might tend to cast the new religion into the shade. Vigorous attacks were made upon superstitions which by their

antiquity or the strength of the popular attachment to them seemed dangerous to the early Christians, and in particular against the devotion it had been customary to give to certain stones. A council held at Arles in 452 notified the bishops in districts where this cult prevailed that if they neglected to destroy it they would be guilty of sacrilege. A council at Tours in 567 advised the clergy to exclude from the church all who performed before certain stones rites strange to it. A century afterward, in 668, the Council of Nantes, calling the attention of the bishops and their servitors to venerated stones in retired and woody spots where vows were made and offerings brought, enjoined them to throw the stones where their worshipers would never be able to find them. The Council of Rouen in 689 denounced those who made vows at stones as if they were altars, or who offered candles and presents before them as if some power resided within them that could dispense good and harm. Two councils at Toledo, in 681 and 693, threatened "the venerators of stones" with various penalties. The worship of stones figured in a list of superstitions still in use at that period drawn up in 743 by a council at Leptines, near Mons. These customs were also denounced in royal ordinances and episcopal instructions. A decree of Chilperic in the second half of the sixth century ordered the stone monuments standing in the fields to be destroyed. In the middle of the next century, St. Eloi, Bishop of Noyon, prohibited Christians from performing vows or diabolical ceremonies around stones. We read in the Capitulary of Charlemagne, which was drawn up at Aix-la-Chapelle in 789, "On the subject of stones to which some foolish people come and give themselves up to superstitious practices, we order that this abuse so detestable and so execrable to God be abolished and destroyed." Similar measures were adopted in England. A decree of Edgar in 967 threatened with terrible punishments those who should perform before certain stones practices savoring of their ancient consecration, or who should omit to destroy them. The decree does not seem, however, to have been of much effect. Canute was obliged to renew it in an edict which characterized such worship of stones as barbarous.

The effect of these ordinances and threats was far from complete. The people kept on in their old ways. The church, not succeeding in destroying the reverence in which the megalithic monuments were held, and fearing the wrath of the people if they overthrew them, decided to sanctify them, to put them under the care of the Virgin, and to derive some profit from the worship paid them. It was necessary, as Fréminville says, to resort to pious frauds and senseless modifications.

A considerable number of menhirs have preserved evident traces

of efforts made at different times to Christianize them. The Christians were satisfied at first to scratch rude crosses upon their faces.

Sometimes, however, more regularity was first given to their shapes by rounding off their tops or marking rough panels on them, and adding to the cross other figures and inscriptions. Many monuments thus treated may be found in Morbihan. The crosses cut upon these stones, particularly in Brittany, generally have the four branches equal. They are Maltese crosses, furnished with feet or braces at the bottom, of very ancient forms—some seeming to be earlier than of the ninth century, and possibly, with their ornaments too, dating from the Merovingian period. Some menhirs have been cut so as to give them a more or less regular form of a cross, and have curious designs sculptured in their faces in intaglio or relief, of certainly quite as remote an epoch.

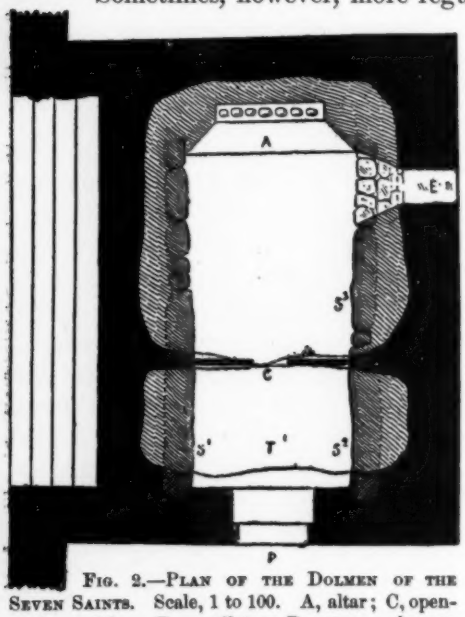


FIG. 2.—PLAN OF THE DOLMEN OF THE SEVEN SAINTS. Scale, 1 to 100. A, altar; C, openwork partition; E, ventilator; P, entrance door to the dolmen; S^1, S^2, S^3, supports; T^1, T^2, tables.

More frequently a cross has simply been planted on a monolith, and instances of the kind are not rare in France. Of these, a cross on the Great Stone at La Rigandière, in the commune of Tour-Landy, (Maine-et-Loire), was erected as recently as 1862. These crosses are of stone or wood; a large wooden cross with a Christ on the *Pierre de Champs Dolent*—a regularly shaped stone more than twenty feet high—has been renewed several times. A number of menhirs dedicated to the Virgin or to saints have been adorned with statues. A menhir in the Isle of Hoëdic, Morbihan, thirteen feet high, which has become an object of pilgrimage, has a niche hollowed in one of its faces to accommodate a statue of the Virgin. The *Pierre Fritte*, in the department of Maine-et-Loire, has a niche containing an ancient statue of the Virgin in painted faïence, inclosed with an iron grating. A large painted wooden statue representing St. Peter, patron of the parish, was placed in 1878 on a granite block twenty-five feet high, in the parish of Pedernec. In the same department of Côtes-du-Nord is a stone picturesquely decorated with a wooden

statue of the Virgin reposing, attended by three other less modern statues representing a man and two saints. Numerous chapels have been built at menhirs to receive the offerings of pilgrims visiting them.

The most remarkable of all the menhirs on which the Roman Catholic religion has placed its seal, and at the same time one of the least known of them, is that of Pleumeur-Bodou, department of Côtes-du-Nord—a handsome granite block, solidly planted in the ground, roughly rectangular, about twenty feet high, and topping in an obtuse point. It is rendered particularly interesting by the religious imagery that covers its southern face. The whole upper third of this face is occupied by quaint sculptures in relief, colored in red, yellow, white, and black, representing a complete series of the attributes of the passion of Jesus Christ. There are the purse, red, containing the thirty pieces of silver which Judas received for his treason, and eight of the pieces shown; the cup, yellow, which Jesus handed round to his apostles at the last supper; the sword, white with a yellow hilt, indicating the arms borne by the persons who came to arrest him; the lantern carried by Judas at the betrayal; the sword with which Peter cut off the ear of Malchus; the cock that crowed three times; the post at which Jesus was scourged, with the scourge and rods; the reed which the soldiers derisively put in Jesus' hand as a scepter; the vessel in which Pontius Pilate washed his hands before giving Jesus up to the mob; St. Veronica's handkerchief; the hammer and three of the nails with which Jesus was nailed to the cross; the dice which the soldiers cast for his robe, and the robe; Mary Magdalene praying; the sun and the moon, which were obscured; the sponge with which Jesus was given vinegar, and the lance that was thrust into his side; a skull and bones symbolizing the opening of the tombs when Jesus expired; the pincers and the ladder by the aid of which Joseph of Arimathea took him down from the cross; and the glove in which Nicodemus caught a few drops of Jesus' blood while burying him. Beneath these figures was depicted a large Christ fixed on a red cross, with a dark background standing for a cloth, five feet by eight. The

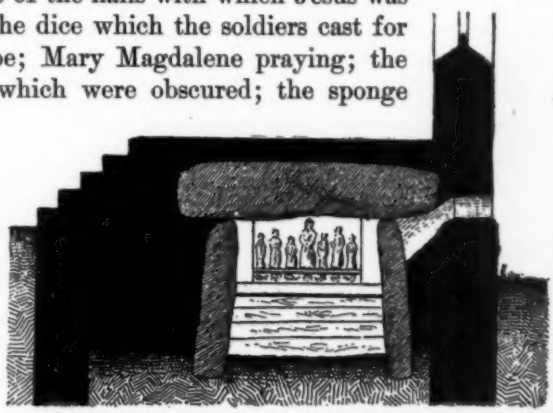


FIG. 3.—TRANSVERSAL SECTION OF THE DOLMEN OF THE SEVEN SAINTS. Scale, 1 to 100.

top of the decorated face of the stone has been shaped into a pediment rising to a kind of base supporting a cross on which is sculptured in bold relief a Christ holding a cup in each hand. The execution of these figures is rude, but the style of some of the designs relates them to the age of Louis XIII, or the beginning of the seventeenth century. The paint with which they are colored can not but suffer from the weather and has to be renewed at times. It looks now comparatively fresh.

Among the dolmens that have been sanctified by the church, some have been used as supports for the cross, and others have been transformed into altars or converted into chapels. Besides the cathedrals of Chartres and Puy, which according to local traditions were built over dolmens very anciently held in reverence, many examples may be cited of megalithic structures which bear the marks of the more or less important modifications they have suffered in view of their changed destination. The partly fallen dolmen of Cruz-Molten, not far from Carnac, bears a very simple stone cross that takes the place of an ancient historical one, of which a view appears on a picture made in 1845. Another monument consists of a slab which is supposed to have belonged to a dolmen, that rests upon four pillars supposed to have been borrowed from neighboring ruins, and supports a cross apparently more recent. The monument supposed to be the tomb of St. Ethbin at Port Mort, which people having kidney troubles pass under on certain days to be cured, was a dolmen, for which a table supported by four small columns was substituted about 1875. So probably was the *Grosse Pierre* of Ymase, a roughly squared slab with a cross cut in one of its corners, sustained by two stone supports, and under which people passed to be cured of various diseases. A rectangular slab resting on four large square pillars at the entrance of the cemetery of Arcy-Saint-Restitue came from a dolmen and is the scene of a sort of religious ceremony. St. Margaret's stone in the commune of Petit Lessac is a large, heavy slab of rough granite resting on four columns of the eleventh or twelfth century, with a stone altar underneath. It was once covered by a chapel, the walls of which could till recently be traced on the surface of the ground.

At Canges de Onis, near Oviedo, in the northeast of Spain, is a little church, built probably in the tenth or eleventh century upon a tumulus of broken stones covering a dolmen. The dolmen, in the shape of a circular chamber with a passage leading to it, is composed of fifteen supports and four tables. It constitutes a part of the church, and was formerly used as a crypt. It has been explored at different times, and a few articles of stone and copper have been found in it. Père Carvallo, a writer of the seventeenth century, says that in his

time devotees regarded grottoes of this sort as the burial places of holy bodies, and scratched up the ground in them for the cure of their diseases.

A megalithic monument in France of similar character is represented by the church of *Sept Saints* (of Seven Saints), in the hamlet of that name, which was built between 1702 and 1744, probably on the site of an older chapel. There is nothing remarkable in the church itself, which is in the form of a Latin cross, oriented in the orthodox direction, with a simple rustic steeple of some beauty. The arms of the cross constitute two chapels, in one of which is the sacristy, while the other one covers the crypt, which gives the church all its interest. On going down into this crypt one may realize without difficulty that he is in a real dolmen which has been converted into a place of worship. Two large granite tables resting on vertical slabs appertain to the primitive monument. A fourth support, now masked, apparently closes the end of the chamber. The chamber is rectangular, and its walls are filled in with stonework. It is divided by an openwork wooden partition provided with a door into two unequal parts, of which the front one is a sort of vestibule, and the other, with a floor sunk about a foot, is the chapel proper. It is dimly lighted, and at the end is a stone altar planked in front, over which is a niche containing seven small statues in a line, made in the most rudimentary style, and painted in colors tarnished with age. These represent the seven saints whose remains tradition says were found in the dolmen, and in honor of whom the church is named. These personages are likewise represented in the church by more imposing and more freshly colored wooden statues, but pilgrims prefer to pay their devotions to the old, faded, miraculously discovered statuettes below. The dolmen has probably, as Luzel affirms, been a cherished holy place from antiquity, and Christianity has simply given a sort of consecration to the pagan tradition. It is the subject of numerous legends, the most famous of which is the Breton story of the *Gwerz des Sept Saints*, which makes it of divine origin, and is in other respects almost the exact counterpart of the legend of the Seven Sleepers of Ephesus.—*Translated for the Popular Science Monthly from the Revue Mensuelle de l'Ecole d'Anthropologie.*

THE English Physical Society visited Eton in February, and were welcomed by Prof. T. C. Porter, who spoke of the value of the classics, on which Eton College prides itself, in education; and expressed the belief that others as well as himself desired that this reverent tradition of the classics should be preserved at the school; "at the same time they would agree with him that there was no better supplement to classics than a fair knowledge of the natural sciences."

COLLEGE WOMEN AND THE NEW SCIENCE.

By CHARLOTTE SMITH ANGSTMAN.

IT is only after many years of earnest work on the part of comparatively few that it is beginning to be understood that domestic science is something definite, reducible to forms, capable of being studied comprehensively, and worthy of a place beside the other sciences in the curriculum of important universities and colleges.

Women have gone to college and heard lectures on physiology in an atmosphere of eighty-five degrees, heavy with carbonic-acid gas, and then passed to others where the thermometer read sixty-five degrees and the chill air from without blew upon their heads, wondering that such things could be side by side with perfect theoretical instruction.

They have gone from new knowledge of bacteria to a certainty of the existence of unwholesome germs in the improperly-cared-for furnishings of their student apartments.

They have learned the composition of the blood, bone, and muscle of human beings, and what substances contain their chemical elements, and then have asked what better use could be made of this knowledge than in securing diets which should perfectly nourish.

They have studied political economy and sociology, and have returned to reflect and observe that their principles are applicable to the social and domestic problems which are now before their eyes.

In the study of mathematics they have learned that nothing wrong can be righted without going to its root, and so have naturally turned their minds to the causes of the complications in domestic machinery which are apparent on every hand.

The study of history has made them realize that any plan for improvement in any condition of things, in order to rest upon a sure foundation, must be based upon a knowledge of the past.

Returned to find herself face to face with practical problems and having her logic still in mind, the college woman asks why such a foundation as she finds has been laid by Miss Juliet Corson in a knowledge of toothsome cookery should not be utilized as a foundation for scientific cookery.

In a four-years' contact with professors and students, she has learned the value of definite knowledge, and now sees as few else could its necessity in order to make any headway with the vexed questions lying nearest her, for to her especially belongs the solution of home problems through daily contact with their minute details, through her woman's nature which nothing can efface, and on account of her special opportunities.

With the thirty thousand girls who have already graduated from colleges, according to Alice Freeman Palmer, carrying these reasonings into innumerable towns and hamlets, the outcome must be something definite, and it is no source of surprise to find that some of them have gradually collected the present knowledge on all topics relating to the welfare of the home, under the comprehensive title of household economics or domestic science, and that great numbers of them are working hard in various lines of this subject.

Let us examine this work of some of our college graduates who have done most in this direction.

The active interest of college women in the subject of household economics was shown as long ago as 1883, when the Boston branch of the Collegiate Alumnæ organized its Sanitary Science Club, the first organization of distinctively college women for the study of any branch of household economics. The report at the end of its first year's work says: "The members of the Sanitary Science Club can not too strongly urge upon the Association of Collegiate Alumnæ the importance of giving thought and attention to the hygiene of the home. This duty falls more or less upon all women, but with none should it be more exacting than with college graduates."

The efforts of this club for science in the home have been productive of great results, as we shall see.

After five years' study, a manual for housekeepers, called Home Sanitation, was prepared by this club and edited by two of its members, Mrs. Ellen H. Richards and Miss Marion Talbot. This manual has been for some time one of the standard works upon the subject, and used as a basis for study in home science clubs.

One of these editors, Miss Marion Talbot, who has the degrees of A. B. and A. M. from Boston University, and of S. B. from the Massachusetts Institute of Technology, after having first realized the importance of the subject in this club, began lecturing regularly upon domestic science in 1886 at La Salle Seminary, and continued till 1890, when she took charge of this department at Wellesley College. In 1892 she was called to the University of Chicago as dean of the woman's department, where she is now carrying on courses in sanitation and the study of foods.

The first interest of the other editor of Home Sanitation, Mrs. Ellen H. Richards, in domestic science dated from a much earlier period. Having graduated at Vassar in 1870, she went to the Massachusetts Institute of Technology to work in the chemical laboratory preparatory to taking the degree of S. B., which she received from that institution, as well as the degree of M. A. from Vassar, in 1873. While working in the chemical laboratory in 1871, a prominent educator, now deceased, made the sneering remark to her, "What

good do you expect all this will do you in the kitchen?" "As if," as she says, "I was necessarily to spend my life in the kitchen, or as if there was no chemistry to be used in the kitchen!"

Even sneers have their value, since, as we shall see in this case, they are often the spurs to great achievements.

Shortly after the culmination of the work of the Sanitary Science Club in Home Sanitation, in the fall of 1889, Mrs. Mary Hinman Abel, a graduate of Elmira College, returned from a six-years' residence in different European cities with the idea that something might be done toward the better nourishment of the working people, such as she had seen in Germany and Austria in the *Volksküche*, and in the *Fourneau Économique* in France.

During her husband's prolonged absence in Europe, she went for six months to stay with Mrs. Ellen H. Richards, now professor of sanitary chemistry in the Massachusetts Institute of Technology, who had become especially interested in her through being one of the judges in the matter of the prize of five hundred dollars offered by Mr. Lomb, of Rochester, N. Y., for the best essay on practical sanitary and economic cooking. Mrs. Abel won this prize, and her little volume bearing this title is considered the simplest and still the most scientific presentation of the subject yet made.

The fruit of this six-months' companionship was the now famous New England Kitchen, started under Mrs. Abel's direct charge. Even the first meeting of these two women foreshadowed the future developments along this line, for then, in mentioning the needs of the working people in this country, Mrs. Richards remarked that Mrs. Quincy A. Shaw, of Boston, and a daughter of the scientist Louis Agassiz, had been ready for some time with the money which might be necessary for such an experiment, she having especially in mind the establishment of a place which, by furnishing cheap and good food, should help to keep laboring men from the saloons.

Mrs. Shaw, having only the benevolent idea in mind, relied entirely upon her friend Mrs. Richards as to ways and means, but agreed with both her and Mrs. Abel that much experiment and the gathering of information must underlie true philanthropy in this direction.

The principles upon which this experiment rested were, then, as they said, the necessity of finding out "how people live, how they cook, and what they buy ready cooked, in order to lay out any satisfactory plan of reform," and the value of bringing absolute accuracy into certain departments of food preparation, so that a physician in ordering an article of diet—beef broth, for instance—might know just what unvarying nutrients it would contain.

In accordance with these ideas and plans, a first-floor room and

cellar were rented at 142 Pleasant Street, "a respectable part of the city, consisting mostly of small shops and of houses let out in flats or rooms, and occupied by people who follow various trades."

By January 24, 1890, the kitchen was opened for the sale of food, it offering at that time beef broth, vegetable soup, pea soup, corn mush, boiled hominy, oatmeal mush, cracked wheat, and spiced beef. Since then other preparations have been added.

Every dish offered by the kitchen is what would be known as a standard dish as compared with one suited only to occasional times. In order to be able to offer standard dishes, the requirements which they must meet were several. "First, the cost of material must not go beyond a certain limit. Second, the labor of making it must not be too great. Third, it must be really nutritious and healthful. Fourth, it must be in a form that it could be easily served, and kept hot without loss of flavor. Fifth, it must suit the popular taste enough to be salable."

One of the first things accomplished by the New England Kitchen was the making of beef broth from the cheaper cuts of meat which was unvarying in nutriment and flavor. To this end the broth was frequently analyzed under the supervision of Mrs. Richards at the Massachusetts Institute of Technology.

More than twenty experiments were tried in its preparation, and one gets the best idea of the care which these college women took to have every scientific principle of soup-making carried out by quoting from the first report published: "The old-fashioned method of making soup in a pot on the stove was tried, and given up; the use of a Papin soup digester was no more satisfactory, the difficulty of regulating the heat and of retaining the flavors of the meat being found to be insurmountable. Gas or oil used under a pot gave little better satisfaction, the bottom being always hotter than the top, and the loss of heat from the whole surface proving wasteful. The labor of making soup by these methods was considerable, and it required the constant supervision of an experienced hand; moreover, no way could be devised for making large quantities at a time. Along with these experiments went others with the Aladdin oven, which were so promising in their results that we had tin-lined copper vessels made to utilize the entire capacity of the oven—i. e., thirty quarts—and settled on this method for making the broth. It was found to have these advantages: First, it made the scientific requirements for soup-making possible—i. e., (*a*) long, slow heating before the coagulating point was reached; (*b*) the continuation of the cooking at a temperature slightly below the boiling point, and long enough to get from the bones and tendons that proportion of gelatin which we knew to be desirable; (*c*) the retention of the full flavor; and (*d*)

the production of a soup almost invariable in quality. Second, the greatest possible amount of broth was in this way obtained from a given quantity of meat and bones, no other process approaching it in this respect. Third, the labor involved was very small; nothing, in fact, between the placing of the vessel in the oven and removing it for straining. It suited our convenience also, in that the cooking could be done at night, the meat being prepared during the day; and although the lamp under the oven went out some hours before the soup could be strained, the nonconducting character of the apparatus kept the heat, and prevented any deterioration of the soup. Fourth, the cost of fuel was reduced to a minimum, twenty-five quarts of soup being made with three pints of kerosene, at a cost of less than five cents."

Mrs. Abel says in her little pamphlet, The Story of the New England Kitchen, after giving an account of their experience in soup-making, and final use of the Aladdin oven for that purpose: "This method, with very slight changes, has been in constant use in the kitchen, and has proved perfectly satisfactory. We consider it a real discovery of great value, and we hope it will in time be adopted in large institutions. Its success, like that of every other method we have used, is based upon the most careful study of every detail, and constant vigilance to see that every part is carried out."

This outline of the basis upon which all food is prepared in the New England Kitchen gives us a fair idea of the training which was necessary to these women before they could inaugurate such a work, and to what eminently practical and philanthropic use they have put it.

After the first seven months during which Mrs. Abel was there, the kitchen has been in charge of Miss Sarah E. Wentworth, a graduate of Vassar College, Mrs. Richards continuing her supervision.

That the success of the kitchen is acknowledged is shown by the "procession of pitchers, pails, and cans brought by men, women, and children of many nationalities, for pea soup or beef stew, as a witness to the fact that a really good food is appreciated and will be purchased." It is also shown by the respect and authority which it has attained in scientific circles as well as others. The Board of Education of Boston requested that the kitchen furnish the luncheons at the nine high schools, which it has done for some time, with the most marked results in the cultivation of proper appetites. The boy who formerly brought a lunch prepared with much maternal devotion, of mince pie, pickles, and cake, now of his own accord pays five cents for four large slices of bread and butter and a cup of cocoa.

The Institute of Technology lunch room is also supplied from this place, making in all about sixteen hundred people who are daily supplied with standard foods as defined by Mrs. Richards and Mrs. Abel, while those who buy from the counter and eat at the lunch room of the kitchen will easily make the number two thousand.

Other kitchens have already been started upon the plan of the New England Kitchen—Chicago, Philadelphia, and New York each having similar ones.

It is not too much to expect to see in a few years such kitchens in every large city in our Union, all the outcome of the practical application of the scientific training of two college women to the betterment of, primarily, the physical condition of their fellow-creatures, and, secondarily, their mental and moral condition.

In October, 1890, while yet busy with the development of scientific principles in connection with the New England Kitchen, Mrs. Richards wrote a forceful paper urging upon college women the study of domestic science. In this paper, which was published for the Association of Collegiate Alumnæ, she says: "What is our education worth to us if we can not order our houses in peace and comfort? You say, 'Modern life makes so many demands upon us.' True; but no demand can supersede that of home. . . . Let each young college graduate begin her housekeeping in a simple way, feeling keenly that all her future happiness and the welfare of her family depend on the thoroughness with which she masters at the very beginning the essentials of a home.

"But not only in her own home is there a call for this knowledge of the fundamental principles of healthful living and domestic economy. In all work for the amelioration of the condition of mankind, philanthropic and practical, there must be a basis of knowledge of the laws and forces which science has discovered and harnessed for our use."

In alluding to the New England Kitchen she says: "In this experiment the training of the college woman showed. No mere enthusiasm would have patiently waited, understanding that success is reached only through failure and after a most careful study of every detail, and is maintained only by constant vigilance."

Urging the study of domestic science in colleges, she says: "First, the subject should be put in the college curriculum on a par with the other sciences, and as a summing up of all the science teaching of the course, for chemistry, physics, physiology, biology, and especially bacteriology, are all only the stepping-stones of sanitary science.

"Therefore, in the junior or senior year, after the student has a good groundwork of these sciences, there should be given a course of at least two lectures a week, and four hours of practical work.

"The lectures should treat of—

"1. The house and its foundations and surroundings from a sanitary as well as an architectural standpoint.

"2. The mechanical apparatus of the house, heating, lighting, ventilation, drainage, etc., including methods of testing their efficiency.

"3. Furnishing and general care of a house, including what might be called applied physiology, chemistry of food and nutrition, and the chemistry of cleaning.

"4. Food and clothing of a family.

"5. Relation of domestic service to the general question of labor, with a discussion of present conditions and proposed reforms.

"The practical work should include:—

"1. Visits of inspection, accompanied by the instructor, to houses in process of construction, of good and bad types, both old and new.

"2. Visits to homes where the housekeeper has put in practice some or all of the theories of modern sanitary and economic living.

"3. Conferences with successful and progressive housekeepers.

"4. Practical work and original investigation in the laboratory of sanitary chemistry."

This was the outline originally prepared by Miss Talbot, and describes the course as she gave it at Wellesley in 1891 and 1892, entering upon her work there at about this time.

To show the respect which Mrs. Richards's attainments as a scholar and scientist have won with the world, as well as giving added significance to the fact of her doing so much in the field of domestic science, The Outlook for September, 1897, is quoted: "Her contributions to science have placed her at the head of the domestic science department of one of the leading educational institutions of the country, and have established her as an authority in her own field, a woman whose advice, investigations, and decisions are accepted by the leading scientists and authorities."

Mrs. Richards and Miss Talbot have made themselves felt in connection with this work in still another direction. In the University of Chicago, domestic science is not only taught but practiced. When Mrs. Alice Freeman Palmer and Miss Marion Talbot consented to go there as deans of the woman's department, it was with the understanding that they should have an opportunity to carry out their convictions that college trustees and professors have done their whole duty by their students only when they see that they are properly fed as well as properly taught. Accordingly, when the three halls for the accommodation of the women students were completed, they undertook, with Mrs. Ellen H. Richards as expert adviser, to furnish a dietary which should be kept within a certain cost,

be of the best quality, prepared in the best manner, and at the same time furnish the known scientific requirements of proper nutrition. To this end an analysis was made of every article of food proposed, and a careful record kept of the number of pounds purchased, its price, and chemical value in proteids, or the nitrogen and tissue furnishing properties; the fats needed for fatty tissues and fuel; and the carbohydrates serving principally as fuel, but all three furnishing energy in the form of heat and capacity for work estimated carefully as so many calories.

Every day's *menu* was planned with direct reference to supplying the chemical requirements in their proper proportions, at the same time meeting the other stated requirements.

The results have been most satisfactory in that the family were well fed, and that nearly all gained in weight and in general physical condition while expressing great interest and approval of the experiment. Financially the experiment was also most satisfactory, showing how the price fixed for board, three dollars and a half, is proportioned among the different items entering into its cost. The tables prepared during the long and careful scientific investigation concerning this dietary are also a most valuable contribution as a basis for further experiment, both public and private.

The most of this work has been and is now continuing under the direction of Dean Marion Talbot.

The other dean of the woman's department of Chicago University, Alice Freeman Palmer, a graduate of Michigan University, and later the honored president of Wellesley College, afterward, as one of its trustees, was chiefly instrumental in having the new science introduced there. Later she has been lending her strength to this subject as a member of the Massachusetts State Board of Education; as president of the Woman's Education Association of Boston, which last year had an important exhibit of domestic art and science, and which now has a strong committee on domestic science; as a member of the committee on domestic service investigation of the Boston branch of the Association of Collegiate Alumnæ; in introducing something of this work into the vacation schools in Cambridge. She is also identified with the movement in Boston to introduce domestic science into public and private schools and colleges, and which last fall established a school of domestic service to attack the problem in another way. That band of twelve college women who organized the Sanitary Science Club in November, 1883, builded better than they knew.

While some of our college women have given so much thought and effort to secure nutritious and attractive diet for those under their charge, who in turn will go out and preach this new gospel of

right living, other college women are teaching scientific cookery directly.

Miss Lucy C. Andrews, a B. A. from Michigan University, studied cooking at Purdue University and the New York Cooking School, and has taught the subject for the last seven years by giving demonstration lectures and holding practice classes for ladies, house servants, shop girls, and children. She has also worked to promote the interests of domestic science in schools.

Dr. Helen Putnam, president of the Collegiate Alumnæ of the woman's department of Brown University, gave in November, 1893, a series of lectures on Cooking for the Sick, at the first food exhibition ever held in Providence. The Collegiate Alumnæ of her university attended as special guests, as also undergraduates (women), with professors and friends, the superintendent of nurses with a corps of nurses from the Rhode Island Hospital, and many of the school committee of the city and members of the State Board of Education.

Who can overestimate the results when this college woman so clothed her subject with dignity and interest that it commanded the attention of such a body of distinguished listeners? Still others are teaching cooking in schools and colleges in connection with other branches of the subject.

The agricultural colleges are making rapid strides in developing this science. The Agricultural College of Kansas has been one of the pioneers in this direction.

Mrs. Nellie Sawyer Kedzie, a daughter-in-law of the eminent chemist, Prof. Robert Kedzie of the Agricultural College of Michigan, first graduated from the college to which she returned to inaugurate the department of domestic science, remaining for fifteen years. She has now been called to continue the same work in the Bradley Polytechnic Institute of Peoria, Illinois, an institution liberally endowed and wide in its scope.

The Kansas Agricultural College has had its department of domestic science so well equipped and so ably conducted by Mrs. Kedzie since 1882 that it has furnished the model for many Western colleges. The work has been so popular there that the Kansas Legislature has appropriated sixteen thousand dollars for a special domestic economy building, which is shortly to be completed.

Mrs. Helen Campbell goes to take Mrs. Kedzie's place from the University of Wisconsin, where she had already done brilliant work as a teacher in household economics. During many years she had given the brilliancy of her pen to books in this field, as well as in others. Some of them are: The Easiest Way in Housekeeping and Cooking, In Foreign Kitchens, The What-to-do Club, a story for girls, Woman Wage Earners, and her twelve lectures called House-

hold Economics, given at the University of Wisconsin, have been published and most warmly received.

Other agricultural colleges are working along these lines. Iowa has a fine equipment in the food laboratory or kitchen in charge of Miss Gertrude Coburn, a graduate of the Kansas Agricultural College. North and South Dakota have valuable courses in domestic science; also Fort Collins, Colorado; the Storrs Agricultural College, Connecticut; and the Michigan Agricultural College, where the course is in charge of Miss Edith F. McDermott, a graduate of Drexel Institute.

Quite possibly they have done so much in the direction of this science, realizing the criticism of Mrs. Ellen H. Richards. She says there are some fifty agricultural colleges and experiment stations in the United States, costing many millions of money, for the study of the food of pigs, cows, and horses. A cow is worth, perhaps, on an average, fifty dollars. It is important that she should be well fed, so that the most may be made of her capabilities. A man is worth three thousand dollars to three hundred thousand dollars, measured by his capabilities, salary, etc. (Five per cent of three thousand dollars equals one hundred and fifty dollars, the salary of a very ignorant man; five per cent of thirty thousand dollars equals fifteen hundred dollars, a common salary of teachers; while fifteen thousand dollars is the common salary of a skilled engineer.) We send our young men to college to be fitted for thirty-thousand-dollar teachers and three-hundred-thousand-dollar engineers, and we take less care of their food than does the farmer of his fifty-dollar cow.

That there is a strong demand for courses in which the study of chemistry shall be applied to food, economics of the household, and its kindred subjects, is evinced by the number of colleges where these subjects are now taught. This age is awakening to the fact that women need special opportunities as *women;* and after the first blind rush for equal opportunities with men for higher education, it is demanding courses of instruction which shall include full credit-earning courses in that combination of sciences which is woman's own.

Important coeducational institutions besides Chicago University give instruction now in domestic science, while others are considering the matter. Wisconsin State University has already been mentioned. The Leland Stanford, Jr., University has lately done admirable work under the able direction of Mrs. Mary Roberts Smith, a graduate of Cornell, and for some years professor of history at Wellesley College. These, with the Boston Institute of Technology and Ohio State University, are a few which have already been teaching the subject, while inquiries are continually coming from many more, as well as from large seminaries.

Many collegiate institutions, such as Drexel Institute, Pratt Institute, and Armour Institute, have given the subject careful attention for a number of years. Even in high schools and grammar schools this work is making its way. To-day a study of cooking is required of every girl in the Boston common schools, as well as in other schools in Massachusetts. In the Providence Manual Training High School, Miss Abbie L. Marlatt, a graduate of the Kansas Agricultural College, conducts a most admirable course in domestic science, covering a period of four years. In the Brookline (Massachusetts) public schools, Mrs. Alice P. Norton, a graduate of Smith College, has arranged and conducts a comprehensive course of study in this department, beginning with the sixth grade and continuing through the high school. This course, as arranged and conducted by her, is a good example of what might be done in the public schools of every city, without crowding out anything of importance or overburdening the pupils. In the sixth grade, where it begins, it only occupies one hour per week; in the seventh and eighth grades, two hours per week; and in the ninth, one hour per week.

The course is systematic and comprehensive, beginnnig with the general care of the house in the sixth grade and progressing to food principles taught with practical tests in a way to become ineradicably fixed in the young mind. For instance, the effect of different temperatures upon albuminous foods and upon starchy foods, with practical illustrations of albuminous cookery and starch cookery, are given, as also tests for proteid, starch, and sugar. Each step forward in the study of the chemistry of foods is always illustrated by the cooking of some dish.

In Brookline, when the pupil reaches the high school, she has already been instructed in many more things concerning the house and the preparation of food, with the reason *why*, than the majority of young ladies know when they enter upon the life occupation of mistress of a home.

In the high school this instruction is still further continued to include general chemistry, with special reference to its household application, sanitation, domestic art, clothing, household biology, problems of the home, including the place of the home in society, household management, and domestic service.

Thus this college woman is impressing herself upon the future by realizing in a practical, comprehensive way that the time and place to get a right knowledge of home making, based upon the latest and best gleaned from many fields, is at that time of their lives when our future home makers are to be reached collectively, and when they are at a good age to receive such instruction, being comparatively undistracted by other occupations and preconceived ideas.

Acting upon these convictions, other college women have been active in the attempt to introduce various branches of the new science into the public schools of their cities, among which may be mentioned Buffalo, Cambridge, and Detroit.

In Boston, college women have applied sanitary science directly to the public schools, as well as helping to secure it in the course of instruction. During 1895 a committee of five, constituted by the Boston branch of the Association of Collegiate Alumnæ, investigated the sanitary conditions of the public schools and achieved most noteworthy results. This committee consisted of Mrs. Alice Upton Pearmain, then president of the Boston branch, and now president of the general association; Mrs. Ellen H. Richards, Mrs. Alice P Norton, Miss E. May Dame, and Miss Helena S. Dudley, then head worker of the Boston College Settlement.

One hundred and ninety-three schools of the different grades were investigated. Among them some were found to be entirely unfit for school purposes, a number being unworthy the expense of repairs, others being hired rooms in old dwellings, and one school even being in the basement of a grocery store.

While a grant had been asked and obtained from the Legislature for two million dollars for new buildings, it was found that there were already about seven thousand unoccupied seats in the schools.

In one school the lighting was found to be so bad that eight cases of inflammation of the eyes were sent to the hospital for treatment in one month, while ventilation from within was unworthy of mention, and impossible from without, because of the constant noise from chopping in the wood yard close by, and because of odors from the old-style vaults in the yard and from a near stable containing eighty or ninety horses.

Such conditions were by no means exceptional. Indeed, inadequate heating apparatus, lack of ventilation (eighty per cent of the methods of ventilation not working well), bad odors, and insufficient light were found to exist in the majority of buildings.

Very indefinite rules were also found regulating janitors' duties, with the result that in nearly half of the buildings rooms were dusted only once a week with a feather duster, disinfectants were used in only fifty-seven schools, and the floors in fifty-nine schools had never been washed since built in a period of years ranging from fifty to five years.

This committee has had the satisfaction of securing reform in nearly every instance which was a matter of domestic science, while others requiring legislative enactment are pending.

Such and many more similar instances of the unsanitary conditions of the schools, brought to the attention of those in authority

and the public, prove the painstaking thoroughness with which these women applied this branch of the domestic science to their great task.

College women are working along the lines of the new science in organizations not distinctively their own, such as the Boston Woman's Educational and Industrial Union, which depends upon them for the strength and inspiration to make its work effective. A college woman is upon its board of directors, a graduate of Wellesley has made the investigations in shops and factories regarding the relation of domestic service to work in those places, a Radcliffe student represents its Domestic Reform League in the Domestic Bureau, while its School of Housekeeping has lectures from Prof. Lucy M. Salmon, of Vassar College, Mrs. Alice P. Norton, and Prof. Katherine Coman, of Wellesley College.

So naturally and forcefully do the problems of the house and home appeal to college women, first because they are women, and secondly because their training makes them ready to attack problems in a scientific way, that one of them, Miss Lucy M. Salmon, an M. A. from Michigan University, lent the particular trend of her mind as professor of history in Vassar College to the historical side of the subject. The painstaking labor given is shown in that the basis of her book was the information obtained through answers to five thousand blanks sent out by her during 1889 and 1890. Her valuable volume, Domestic Service, was finally published in the spring of 1897.

Her hope that "the tabulation and presentation of the facts will afford a broader basis for a general discussion than has been possible without them; that a knowledge of the conditions of domestic service beyond their own localities and households will enable some housekeepers in time to decide more easily the economic questions arising within every home; that it will do a little something to stimulate discussion of the subject on other bases than the purely personal one," has been promptly realized in one distinguished instance at least, since the Boston branch of the Association of Collegiate Alumnæ has been making this year a scientific study of the subject of domestic service, with her book as the basis for preliminary work, recommending it as "the most careful scientific investigation of the subject up to date."

The American Kitchen Magazine shows how college women are giving of their best to put before the public scientific and practical knowledge upon all matters pertaining to the home. Home is the magnet to which their thoughts and efforts are continually drawn. Frequent contributors to this publication are Mrs. Mary Roberts Smith, Mrs. Ellen H. Richards, Miss Lucy C. Andrews, Dr. Mary E. Greene, president of the National Household Economic Associa-

tion, Mrs. Helen Campbell, Mrs. Mary Hinman Abel, Miss Edith F. McDermott, Mrs. Alice P. Norton, and others, in such papers as Household Labor as Exercise, Chemistry of Cooking and Cleaning, Southern Prize Recipes, and an appeal to girls to learn housework rather than shop or factory work.

The idea of duty and obligation to give to others less fortunate something from the riches of opportunity and training enjoyed by college women so impressed itself upon the mind of a graduate of Smith College, Miss Vida D. Scudder, that she succeeded in imbuing the minds of six other graduates of that institution with her own conviction. Her plan was to establish a home in the midst of a densely populated, ignorant, and wicked district, from which they could reach the homes of their neighbors and add something of pleasure and knowledge to their dull lives full of ignorance and vice.

To these young college girls, the value of a home appeared so great as a nucleus for far-reaching philanthropic work, as the most practical kind of a starting point for anything of value which they could give or receive, that they determined to make one in the worst part of New York city.

Upon maturing their plans, they moved into quarters at 95 Rivington Street in September, 1889, a locality, according to Frances J. Dyer, "said to be more densely populated than any part of London. One half of all arrests for gambling and one tenth of all arrests for crime in New York come within the limits of the election precinct in which they (the residents) live. Five churches vainly try to meet the spiritual needs of fifty thousand people, and there is one saloon for every hundred inhabitants. These facts sufficiently indicate the character of the neighborhood in which these young collegiates, representing the highest type of American womanhood, elect to spend a portion of their time." The steady growing and remarkable results following the efforts of these young college women would furnish material for a volume. From this beginning other college settlements have followed upon the same basis—that one must take to the people what one has for them.

The Alumnæ House Settlement of the New York Normal College opened at 446 East Seventy-second Street, New York city, in 1894; the Philadelphia College Settlement opened at 617 Carver Street in April, 1892; the Boston College Settlement opened at 93 Tyler Street, January, 1893; while many others have followed, fathered by coeducational institutions, such as the University of Chicago Settlement, started in January, 1894, at 4655 Gross Avenue; the Northwestern University Settlement, opened in 1891, at 26 Rice Street, Chicago; and a Log Cabin Settlement, opened in a very small place in the mountains of North Carolina in March, 1895.

In every one of these, the home element is the main idea. Thus the Northwestern University Settlement reports, "The character of the work has been to exalt the home and increase the pleasures of the home makers." The New York Settlement reports in connection with its kindergarten work, "The second year of the kindergarten work has made us realize more deeply than ever how natural and vital is this way of reaching the homes and the confidences of our neighbors." The Mothers' Club of the Boston Settlement has had instruction concerning the sanitary conditions of the neighboring homes, while Dr. Mary Hobart talked to it of proper food for babies, and Mrs. Alice P. Norton has directed the mothers in cutting and making various garments.

The work of college women for the settlements, and through them for better home making, is not confined to settlement residents, as large financial aid has been given all the college settlements by the undergraduates and alumnæ of the twelve or more important colleges for women in the East.

The undergraduates of Smith, Swarthmore, the Woman's College of Baltimore, and Bryn Mawr have assisted the residents of the Philadelphia Settlement in many ways; while Barnard, Elmira, and Packer students consider the New York Settlement as their care, and Wellesley and Radcliffe girls are very helpful at the Boston Settlement.

That the value of a knowledge and practical application of the principles of domestic science as a great factor in the leavening of the community about them is never lost sight of is shown in the establishment by the Philadelphia Settlement of a kitchen and coffee house in the fall of 1895 at the southwest corner of Seventh and Lombard Streets. This was started upon much the same lines as the New England Kitchen, and with the same primary objects—"to furnish to our neighborhood, through the kitchen, nutritious food, properly cooked, at the lowest price consistent with a narrow margin of profit, and to offer, through the coffee house, a clean, cheerful place, free from all objectionable features, where a comfortable lunch or meal might be had at reasonable rates." The expectations in regard to the success of this project have been fully realized, it having been found, as in the case of the New England kitchens in Boston and New York, that "where food can be as easily obtained as drink, many a man will take the food in preference." The number of penny lunches sold during the first year was 21,332, and the number of meals served during June alone was 2,928.

In the Boston Settlement domestic science is used as a means to its ends in the support of mothers' clubs, a kitchen garden for girls

of fourteen and another for girls of eight to ten, a mothers' cooking class in the homes, besides classes in sewing. In fact, in all the settlements this work with the mothers and children, and through them for the homes, is one of the most important.

One young college woman, Miss Alberta Thomas, of the domestic science department of Pratt Institute, Brooklyn, has had the needs of students who wish to board themselves particularly in mind, and has invented an oven upon the principle of the Aladdin oven, which she declares that a housekeeper could improvise with boxes from the grocers. The long cooking necessary makes the food easy to digest and cheap pieces of meat palatable, and also makes possible the leaving of puddings, meats, and vegetables many hours without attention, which is so valuable to the student who is often away many hours at a time. She has lately been experimenting with various *menus* for breakfast, luncheon, and dinner which will be appetizing, contain the necessary amount of nutriment, and give the student but little trouble to prepare, and which can be supplied for one dollar and a half per week.

Not long ago Mrs. Eliza R. Sunderland, a Ph. D. from Michigan University and a Unitarian minister of great ability, reminded her large audience of women that their chief interests must, in the majority of cases, ever center about the home; that women are the natural home makers, and that any system of education which lost sight of this fact was incomplete.

Thus, by addressing popular audiences, by writing magazine articles and books, by demonstration lectures upon the science and art of cookery, by teaching the subject in high schools, grammar schools, and colleges, by the establishment of depots for the sale of scientifically prepared as well as savory food, by practically demonstrating her knowledge in different ways in the homes of her poor neighbors in connection with college settlements, by working upon practical problems connected with domestic science in strong committees connected with education associations and branches of the Association of Collegiate Alumnæ, and in many other ways do we find the college woman working in the field of domestic science, reaching thousands of homes and home makers. All her intellectual training, which it has been feared might divert her energies from home duties which by nature and opportunity she is especially fitted to discharge, has but made her the more eager to discharge them, but with a new and different interest, along better lines thought out as a natural consequence of her new opportunities.

We are getting beyond the day when instinct and Providence were expected to do duty for definite knowledge and special training in the business of home making. The college woman is giving us

methods as a permanent basis for results, and with that largeness of vision and special understanding born of her special opportunities, yet true to her woman's instinct, which nothing can eradicate, has seen what might be bettered, and is bettering it in that place which is most potent for all that is good or evil in life—the home.

SKETCH OF CHARLES GOODYEAR.*

By CLARKE DOOLEY.

IN the rush and whirl toward the end of a century so fertile in discoveries and inventions; when, day by day, we are coming to accept the most marvelous announcements of science and new creations for comfort, for safety, or pleasure with lessening enthusiasm, as if they were only an anticipated right—at such time, when, enjoying so much, the world is already looking forward in reveling wonder to the "Century of Electricity," it were well to single out and assign to their merited place those who have most contributed to make this progress possible. Among them should be ranked Charles Goodyear, the discoverer of vulcanization.

CHARLES GOODYEAR was born in New Haven, Connecticut, December 29, 1800. He was the son of Amasa and Cynthia (Bateman) Goodyear, and a descendant of Stephen Goodyear, who was the associate of Governor Eaton, and after him head of the company of London merchants who founded the colony of New Haven in 1638. Amasa Goodyear was an inventor of important agricultural implements. The boy observed the good accomplished by some of his father's innovations, and this contributed to his inventive bias. His early years were passed in New Haven. He is described as a studious boy; at ten, serious and manly, with no taste for boyish plays, and, if missed, was generally discovered reading. He had no fondness for machinery, but was always trying to improve articles used in the service of the house and farm; when not at school, was usually occupied with his father's business; was a dutiful son, and at sixteen his father showed his confidence by consulting his judgment. He was early under the influence of strong religious impressions, which were to characterize his life, and desired to enter the ministry, but his father's business constrained him to give up the idea. So from seventeen to twenty-one we find him apprenticed at hardware in Philadelphia.

He then returned to Connecticut to become a partner in the

* See also India Rubber and Gutta Percha, by the writer. Popular Science Monthly, March, 1897.

business of his father, and in 1824 married Clarissa Beecher. She was devoted to her husband, and endured without complaint the hard vicissitudes of life which befell them in his long pursuit of his discovery. In 1826 he opened a store in Philadelphia for the sale of hardware, principally the products of their own factory. It was the first for the sale of domestic hardware in the country. Under his management the house acquired an ample fortune, but failed in 1830. It was a great trial to Goodyear, yet he submitted without regrets or loss of courage to what he considered providential.

The next ten years he was repeatedly arrested for debt, not wishing to take the benefit of the bankrupt law. He strove to complete his inventions in hardware, and from the sale of one of them, completed in prison, obtained temporary subsistence. He does not seem to have been depressed, but rather to have grown stronger by reliance on a clear conscience and a lofty purpose. Soon after his reduction from affluence to poverty he decided to devote himself to invention; partly because he felt it would be difficult for him to get rid of the epithets "inventor" and "visionary," so often considered synonymous. Moreover, he is said to have felt himself divinely called by his aptitude, his past course, his circumstances, and a strong inward impulse.

As a schoolboy his attention was drawn to the mysterious property of India rubber. A thin pellicle peeled from a bottle attracted his notice, and suggested that it would be very useful as a fabric if it could be made uniformly so thin and so prepared as to prevent its adhering together and becoming a solid mass, as it soon did from the warmth and pressure of the hand. So his mind was dwelling upon the problem before Thomas Hancock in England made his first unsatisfactory solutions of rubber in oil of turpentine about 1819. The substance began to be known in the United States in 1820; its manufacture to attract attention about 1831.

Modern Europe was unacquainted with rubber until the discovery of America. Uncertainty reigned, some supposing it of animal origin, until 1736. From that time *savants* busied themselves with it. Hancock introduced the first mechanical processes (from 1818), molding, ink-erasers, etc.; Mackintosh his benzene solution and garments in 1823. The shoes made by the South American Indians had been favorably received in Europe; but, at the critical period in the United States, and likewise from deterioration of the gum, the public was abandoning them and many other articles of rubber fabrication.

In the United States rubber became a subject of investigation, and Dr. Comstock obtained a patent in 1828 for its solution in oil of turpentine and its application to stuffs. The first practical success

was attained by E. M. Chaffee (1830), who invented a machine for spreading his oil-of-turpentine solution on cloth. Not to invest in rubber companies about 1833 was thought to indicate a lack of financial insight.

Goodyear read of the success of these companies and, in casting about to help himself, naturally turned to the substance which had earlier attracted his attention. Having made an improvement in the valve of a life-preserver, he returned to the Roxbury Company and tried to sell them his invention. The agent recognized its merit, and, hoping to enlist a clever intelligence in their interests, unfolded to him the startling condition of rubber manufacture in the United States: that the seeming prosperity was not real; that the company had made and sold large quantities of goods in the cool months of 1833–'34, but the following summer the greater part had melted; and that new ingredients and machinery had been vainly tried. He urged him to try to solve the secret, intimating that almost any price would be gladly given. By the end of 1836 the "India-rubber fever" had spent itself, not a solvent company was left, and the very name was detested.

Charles Goodyear at once began his experiments, melting his first gum in the debtors' prison, Philadelphia. He continued them the winter of 1834–'35, making his mixtures with his own hands and rolling them with a rolling pin. He considers it fortunate that rubber is five cents per pound, for as long as he can command that sum he will be able to continue experiments. And he soon discovers that chemists, physicians, and researchers have been baffled in all attempts to make the substance take on the qualities desired. He is thirty-five, bankrupt, and in poor health, yet does not shrink from what to the strongest might well have seemed a superhuman task; and is sustained by "the reflection that what is hidden and unknown, and can not be discovered by scientific research, will most likely be discovered by accident if at all, and by the man who applies himself most perseveringly to the subject." With a friendly loan he makes shoes of fine appearance, but summer finds them reduced to an offensive mass. He thinks there must be some substance to mix with the gum, and tries almost everything he can obtain. None of the learned men indicate the course to be taken; he is on an unknown sea.

He has the best success with magnesia, producing the first white goods; but his beautiful book and piano covers began to ferment, and soon turned brittle and hard. At New Haven he recommenced the work which was to occupy his attention to the end of his life, shoes being the first goods offered, as they were of easy manufacture. This was the beginning of the long-continued family employment

with caoutchouc, his eldest daughter making the first pair of vulcanized shoes that were produced. The gum, dissolved in oil of turpentine, colored with lampblack, and hardened with magnesia, was spread upon flannel, and out of this material finely embossed shoes were made. But they proved to be a failure in the winter of 1835–'36 (Trials of an Inventor, by B. K. Peirce). "It was at this time," says his daughter, "that I remember beginning to see and hear about India rubber. It began to appear in little patches upon the window panes and on the dinner plates. Father took possession of our kitchen for a workshop. He would sit hour after hour, working the gum with his hands."

Goodyear thought the difficulty was in the turpentine, was glad to get some barrels of unthickened sap (alcohol had been added), and hoped to dry the gum so that it would not decompose. His Irish workman announced that he had made the important discovery—having given his trousers a thorough coating of the liquid—and was regarded, as may be imagined, with some dismay, until the trousers soon had to be cut off to enable him to rise from his seat by the fire. The inventor was now satisfied that the stickiness belonged to the gum itself, that it was not a result of the process employed. His early failures were made disheartening by the refusal of friends, to whom he had held out high hopes, to extend further aid. He buried a little son, and was obliged to sell his furniture and resort to the pawnbroker, losing the household linen spun by his wife. Yet he did not lose hope, and still felt confident that God was leading him to the accomplishment of his task. This faith sustained him in what is perhaps *the most remarkable pursuit of a discovery in the realm of invention.*

Alone he reached New York, worn and rusty, his hands covered with "gum elastic," and was supplied with facilities for experiment. He produced good results by boiling the articles, made with magnesia, in quicklime and water, and made thin sheets of gum for the first time (Hancock had done the same). Somebody being asked how Mr. Goodyear might be known, said, "If you meet a man who has on an India-rubber cap, stock, coat, vest, and shoes, with an India-rubber money purse *without a cent of money in it*, that is he." He obtained a patent for his new process and medals at the fairs of the Mechanics' and American Institutes in 1835. He manufactured articles, but, alas! soon found that weak acid neutralized the lime and rendered them sticky. Discouragement only made him more self-sacrificing and determined. His next improvement was somewhat accidental, led to a better sale of his products, and advanced him to the threshold of his great discovery. Being of æsthetic tastes, he was always striving to improve the appearance of his goods. He tried aqua fortis (commer-

cial HNO_3) to remove an excess of bronze from a sheet, and found it dissolved it. Later he examined the piece and found it "cured," as he called it. He does not appear to have known that his acid contained sulphuric acid (North American Review, vol. ci; *Le Caoutchouc et la Gutta Percha*, E. Chapel, p. 47). The cloth was of superior quality and stood heat sufficiently well for many purposes; so he was happy again. A patent was secured (1836) for his "acid-gas" process, and a partner (William Ballard) with large capital readily found. The fabrication of beautiful articles was begun in Bank Street and on Staten Island, whither he removed his family, and recognition was received from many quarters. Before taking out this patent he was so overcome by noxious vapors in his laboratory that he nearly lost his life. Fortune, however, turned again, and the firm was carried under by his partner's affairs in the panic of 1836–'37. This injured him greatly, being ascribed to want of merit in his goods. Reduced to poverty again, he pawned his umbrella to Mr. Vanderbilt to reach the city. Though in direst need, still he did not give up India rubber. The family was helped back to Staten Island, where he was allowed to print piano covers and ladies' aprons in colors and bronze, the sale of which was of some assistance. Their few teacups served both for table and experiments. Attempts to rally the courage of stockholders failed, owing partly to the general gloom prevailing. His persistent faith in gum elastic and his habit of wearing it, to test and advertise it, led to his becoming an object of ridicule, and he was regarded as a monomaniac. But he had the good fortune to find favor with J. Haskins, of the Roxbury Company, who invited him to Boston and proffered him aid.

Despairing of New York, Goodyear secures a loan, and with choice specimens arrives (toward the end of 1837, says E. Chapel) in Roxbury, Massachusetts, where so much had been made and lost in rubber. Former friends in hardware forward his designs as far as they are able. E. M. Chaffee, whose inventive genius had given the industry its initial movement, becomes specially interested, and advises perseverance. Chaffee, supposing, as had Goodyear, that the adhesiveness arose from the oil of turpentine employed, had invented heavy machinery for dissolving the gum without its use; but, as we have seen, the stickiness was inherent in the substance itself. So, old difficulties reappearing, the revival of trade had proved to be but temporary. Chaffee and Haskins secure assistance for Goodyear, and allow him to use the valuable idle machinery in their factory. Prosperity seems to smile again on the indefatigable experimenter. He invents a new process for making shoes and secures a patent, but sells it to meet immediate wants—a course he was often obliged to pursue, thus removing himself from lasting benefits. He also makes

piano covers, table and carriage cloths superior to any that had been produced up to this time in the United States. A demand arises; he is enabled to sell licenses for manufacture, realizing five thousand dollars in a single year; and the family is glad to be united and comfortable in Roxbury. The hopes of the friends of India rubber were rising high.

In the summer of 1838 Goodyear met Nathaniel Hayward, of Woburn, Massachusetts. He had been the foreman of a rubber company, and manufactured on his own account. Hayward had tried powdered charcoal and lime to dry the gum, but now sprinkled sulphur upon it and hardened it by the rays of the sun, claiming to have received the process in a dream. The same discovery was made simultaneously in Germany by Dr. Lüdersdorf. (This chemist was yet to discover that the process only "cured" the surface.) Hayward's discovery had attracted no attention, and had the serious objection of causing a very disagreeable smell whenever employed. Goodyear is surprised to find much the same effect *upon the surface* of the gum as that produced by his "acid-gas" process. He purchases Hayward's patent of February 24, 1839, gives him employment, and manufactures at Woburn and Roxbury. He and others supposed that the process also "cured" the body of the gum. The increased attention excited by rubber at the time led to an order from the Government for mail bags, and he gave it the widest possible publicity. At last the world shall see what he can do! He hastened to gather his family around him to share in the beckoning prosperity, and his aged parents and two younger brothers, sufferers from his failure, joined him. What was his mortification to find his beautiful mail bags decomposing and dropping from their hooks! In late experiments he had been using coloring matters, white lead, vermilion, etc. Introduced freely into the bag composition, they had proved deleterious, as the gum was then "cured." After his final invention he was enabled to make use of them. He says, "Had it not been for this misfortune from the use of these articles, in all human probability the vulcanizing process would never have been discovered."

Our inventor was now at the stage where he could fabricate thin sheets, somewhat durable. How to produce the effect in a mass of the substance? He feels himself near the solution of the question. Outwardly the worst discouragement besets him. Instead of the large fortune his friends had anticipated, his whole invention seems now to be worthless. The public, so often misled by experimenters, becomes utterly disgusted with the business and the material. From comparative ease and comfort Goodyear is once again reduced to absolute want. Everything salable is sold for the payment of debts;

he sees his parents and family deprived of their means of support; he has passed four years in trying to improve a material that has resisted all the ingenuity of investigation, that had ruined so many men, and in which large capital had been lost; and he has given his exclusive attention to the subject. "It was generally agreed," he says, "that the man who could proceed further in a course of this sort is fairly deserving of all the distress brought upon himself." His friends urged him to take up some other business, declaring that he was only bringing discomfort upon himself and others. But he kept on and made a few articles by the old process, by which means and the pawn shops the family was able to live. Had machinery or important capital been necessary, he needs must have relinquished his experiments and abandoned the pursuit of what so many regarded as an *ignis fatuus*. As it was, with a small sum he made experiment upon experiment, trying to retrieve the lost reputation of his invention. The influence of sulphur upon the surface especially interested him. At Woburn his triumphant discovery was to be accomplished. Parlor became workshop. Here with his family and two assistants he manufactured shoes. The family is described as happy in all their extremities; the mother uncomplaining; the father, amid his cares and the struggle to solve the important problem, always genial.

So, in the spring of 1839, he is trying the effect of heat upon the mail-bag compound. While talking in the kitchen with persons familiar with India rubber, he makes a rapid gesture, and a piece of the gum he holds in his hand accidentally comes in contact with the hot stove. As the substance, in its natural state, melts at a low degree of heat, great was his surprise to find that it had charred without dissolving, and that no part of it was sticky. His daughter says: "As I was passing in and out of the room, I casually observed the little piece of gum which he was holding near the fire, and I noticed also that he was unusually animated by some discovery which he had made. He nailed the piece outside in the intense cold. In the morning he brought it in, holding it up exultingly. He had found it perfectly flexible, as it was when he put it out." When further experiments show that his process "cures" the rubber through, and that the new substance resists heat, cold, and the action of acids, and before he has convinced any one of the value of his invention, "I felt myself," he says, "amply repaid for the past, and quite indifferent as to the trials of the future." Two years passed before he was able to convince any one outside of his family of the importance of his discovery. The world had to be shown, by time and varying temperatures, that "metallization" (as the process was first called) was effective. This was a bitter period for the Goodyears. Their condi-

tion became distressing: potatoes gathered before they were grown, school books sold to keep the wolf from the door. Goodyear feared to die before finishing his task. So he struggled on to determine the conditions for best results, boiling his mixtures in saucepans, suspending them from the teakettle, often working far into the night. His yellowed, haggard look and worn rubber coat gave him a wild look. It seemed as if his important secret was to perish with him. A thousand failures were to discover defects. The operation required exactness and promptitude; one condition a failure, all was spoiled; and often he could not apply the heat soon enough. So he saw the necessity of reliable apparatus. Rattier and Guibal, of Paris, made him an offer for his "acid-gas" process, which would have immediately relieved his pressing wants; yet he refused, saying he was perfecting another which would render it worthless. The incident accords with the character of the man. When gloom hung low above the Goodyear cottage, a ray of sunlight came in means for the inventor to reach New York, where William Rider advanced a certain amount for experiments. His family was freed from want, and better conditions for success were obtained.

Before the new firm was well under way Rider failed, and it lost its capital. Goodyear was also manufacturing, at Springfield, Massachusetts, sheets of vulcanized rubber and shirred goods for suspenders and elastics. These were having a large sale. Now that success was attained, his brother-in-law advanced capital to continue the business.

About to continue his enterprise in 1841, he has his last experience with the debtors' prison in the United States. Yielding to remonstrances, he took the bankrupt law; but, when fortune favored him, one of the first things he did was to pay off thirty-five thousand dollars' worth of old claims. He was in no hurry to seek a patent, considering his invention safe, and was more intent on its perfection for the good of humanity than regardful of his personal interests. So Hancock, in England, scraping Goodyear's samples and smelling the sulphur, persevered until he rediscovered the process, and first obtained a patent, November 21, 1843. He and Brockedon (who secured the samples) named the operation "vulcanization." It was ten years after beginning his experiments before Goodyear felt able to produce perfectly vulcanized rubber with economy and certainty. Then, apprised by his agent (Newton, who hastily took patents in his own name in France, January 8, and in England, January 30, 1844) of what Hancock had done, he took out an American patent, June 15, 1844. The same summer he introduced his "steam process" for dissolving without solvents. It cost several years of trials to get rid of the liability of fabrics to peel off, but he succeeded at last by mix-

ing fiber with the gum. He considered this invention only second to vulcanization. When he had brought the fabrication of shoes to sufficient perfection, he disposed of his rights for one half cent a pair. Thus, when he should have been in condition to enjoy the fruits of his discoveries, he was harassed by financial cares to the end of his days. An idea of the business he opened up to others may be formed from the fact that the companies holding the shoe rights paid Daniel Webster a fee of twenty-five thousand dollars for his triumphant defense in 1852. It was the last legal argument Webster made, and has been considered a fitting close to his brilliant professional career (The Green Bag, vol. vii). Webster's story will serve to keep in mind the effects of cold on unvulcanized rubber: receiving a present of a cloak and hat, he one day stood the stiffened cloak on the veranda, the hat on top. Several worthy citizens, passing afterward, respectfully saluted the strange figure, thinking it was the sage himself.

After vulcanization was an established fact and patented in Europe and the United States, Goodyear worked on for sixteen years in the effort to apply rubber to new and especially humanitarian uses —life-saving appliances on water, sails, water beds, etc. In personal expenditures reasonable, he was very prodigal in his experiments— often from the desire to save time or to test his ideas upon a sufficiently large scale. It was his habit to have light and writing material at hand at night, and thus many things were recorded by his own hand, or by dictation, that would otherwise have been lost. A prey to dyspepsia, liable to attacks of gout, and delicate as he was, his achievement is the more remarkable. He received over sixty patents, yet his chief benefit, relatively, may be said to have been the consciousness of working for mankind. His rights were infringed; litigation and experiments consumed large sums. "No inventor, probably," says the commissioner, granting an extension of patent in 1858, "has ever been so harassed, so trampled upon, so plundered by that sordid and licentious class of infringers known in the parlance of the world as 'pirates.' The spoliation of their incessant guerrilla warfare upon his defenseless rights has unquestionably amounted to millions." He spent much time and money upon rubber sails, which, from greater impermeability, were to be smaller, from nonliability to mildew, more durable; and, being nonfreezing, to prove a great relief to sailors on northern coasts; and he died in the conviction that they would supersede all others. Captain Popham, on whose ship they were tried, accorded them high praise. Goodyear's experiments also laid the basis for hard-rubber manufacture. Gail Borden, famous for his condensed-milk process, once said to one of Mr. Goodyear's sons: "After experimenting unsuccessfully so many

years, I should have given up in despair if I had not read a sketch of your father's life."

In 1853 he published, for friends and private circulation, and made entirely of rubber, Gum Elastic and its Varieties, with a Detailed Account of its Application and Uses, and of the Discovery of Vulcanization, copies of which, we are informed, are still in existence. With better instincts for business and willingness to stop and gather the fruits of his labors, as friends often urged, Goodyear might have realized an immense fortune. But almost everywhere he was unfortunate in protecting his rights. Hancock had to admit that he saw the first sample of vulcanized rubber in the hands of Goodyear's agent; yet, both in England and France (where Hancock's process had been introduced), rights were lost through technical difficulties. He spent thirty thousand dollars on his beautiful exhibit at the London Exposition in 1851, and obtained a medal. In 1852 he went with his family to Europe to establish his patents and improve and introduce articles manufactured under them. His wife died in a foreign land, and in 1854 he married Fanny Wardell, of London. Foreseeing the importance of hard rubber, he was the more easily induced to make a lavish display at the Paris Exposition in 1855, where, at an expense of fifty thousand dollars, he exhibited inlaid rubber furniture, jewelry, ornaments, carved caskets, painted panels, etc., obtaining a grand medal, and later a ribbon of the Legion of Honor.

The exposition and his agents' mismanagement abroad and dishonesty at home drew him into greater financial difficulties, and he was imprisoned in Paris for debt. Lack of experienced workmen and necessary heavy machinery in Vienna, the reversal of a favorable decision by a French court, failures in the United States affecting European houses, and a decline in rubber manufacture, all contributing to embarrass his condition, he was obliged to renew his loans on ruinous terms. From April, 1856, to May, 1858, he resided at Bath, worried by debts, a prey, even then, of the pawnbroker, tormented by the gout, yet still experimenting with life-saving appliances. He would have been extremely poor had not his patent been extended for seven years soon after. By the winter of 1859, besides his home in New Haven, he had a residence in Washington fitted with a large bath for trying the life-saving boats and apparatus upon whose perfection he was so intent. Thus, when he might at last have rested, he could not, as his mind was constantly dwelling on the needs and perils of mankind. It is curious that he should have been last employed with a life-preserver, the subject which had engaged his attention at the outset. With a friend he started for Connecticut to see his dying daughter, going by steamer, on account of his delicate

health, as far as New York. On reaching that city they received intelligence of her death. As Mr. Goodyear was unable to continue the journey, they repaired to the Fifth Avenue Hotel, where he afterward died, as the church bells were ringing, Sunday morning, July 1, 1860. Of nine children, five survived him.

Some of the published biographical sketches of the discoverer convey the idea that he left an insolvent estate. From his surviving son, Prof. William H. Goodyear, we learn that the greater part of the last fifteen years of his father's life was passed in comfortable circumstances; and that his estate, though his affairs were somewhat complicated at the time of his death, was worth several hundred thousand dollars, the greater part of which was ultimately invested profitably in the well-known Goodyear shoe-sewing machine (an invention improved by Charles Goodyear, *fils*). An effort was made to extend his patent a second time for the benefit of his family. But it was not very difficult for those grown rich out of his discovery to point out improvidence—particularly in his later years—and so, with the cry of "Monopoly," raised in the press, the project was frustrated. The whole tenor of his life shows him to have been a man of most honorable intentions. He gave cheerfully and unsparingly for benevolence when he had the means. Further, it goes almost without saying that he never neglected those who had assisted him, and that he promoted their welfare, and that of his relatives, to the extent of his ability. Palissy, the celebrated rediscoverer of white enameling, knew that the process had been accomplished before. But Charles Goodyear was not in the same position in regard to vulcanization, and his chief merit may, therefore, be said to have been his *remarkable faith* in its final accomplishment, which inspired his untiring pursuit of his idea under the most adverse conditions. From France, in *Le Caoutchouc et la Gutta Percha*, by E. Chapel, comes a note of worthy appreciation and *a suggestion* which should find echo on this side of the ocean: "Sufficient account has not been taken, in the United States, of the character of this researcher; it is owing to him that we have been able to take so great advantage of caoutchouc, that its employment has become indispensable in medicine, in chemistry, in physics, in electricity—in a word, in all the arts and sciences, in which, in many cases, it permits the realization of progress of the highest importance. We should consider Goodyear one of the benefactors of his race, and must regret that no statue to that end has been raised to this Bernard de Palissy of the New World."

Correspondence.

COMPETITION AND SOCIALISM.

Editor Popular Science Monthly:

DEAR SIR: In reading over your June magazine this morning I came upon your very able essay on Competition and the Golden Rule. I am very much impressed with its general fairness as well as its penetration, but particularly with the opening paragraph on those advocates of socialism who teach that competition is a negation of the golden rule.

I feel that I ought to admit you are justified in treating all socialists as if they were enemies of competition; and I grow quite disgruntled myself with those of my fellow-advocates who are continually denouncing competition in the way you have described. I am quite willing to confess that if any further arguments were needed in defense of competition, your article supplies them; and that true competition—i. e., between the individual faculties and energies of individuals—is an element of life itself, which no institution, even were it desired, could for any extended period wipe away.

But what I should like to call your attention to, if kindly permitted, is that modern socialism (the replacing of privately owned capital by socially owned, or functional, capital in the production and distribution of wealth) does not involve a negation of competition. You are, of course, familiar with the general expression of the object of socialism, "To every man according to his deed." If every man is to be rewarded "according to his deed," it is possible only by observing the competitive attainments of each and all.

But it may be said that that is a mere banner declaration, and that we must look to the necessary workings of the socialistic system in order to determine its regard for competition. Admitted.

Now, as I have been able to understand the necessary effect of the "replacement of private by social capital," its only consequence as to competition would be in eliminating such competition as between the units of capital, or dollar and dollar; for example, to such competition as we now see going on between the different bodies of capital—as in parallel railroads, the multitude of stores, etc. In the interest of a sound political economy it is, indeed, desired that this prodigious waste of both capital and individual energy, arising from the anarchy of private capital, should be stopped. That is, the two railroads should not be laid where one might meet the needs of society, etc.; but that the utmost economy of capital should be insisted on in modern society, where the absolute interdependence of our lives makes the present waste (about fifty per cent of our capital and labor) a terrible tax upon all.

While, therefore, competition between bodies of capital when engaged in organized production or distribution *is* in fact sought to be eliminated because of its terrible expense, this consequence in no way follows as to the vastly more important human constituents of the system. "To every man according to his deed" will mean, with important modifications, the same wage system we now have and the same relative ratio of service with reward. We believe—we think we know—that wages will double or treble under the elimination of rent, interest, and profit, and that other monster with no defenders—*waste;* that an Edison and many others will make immensely more money, according to their deed, than their poorly equipped moral, mental, or physical competitors. But at the same time that every man's possessions will be limited to his actual wages, it is fairly expected that his influence and power in the government of the world will be similarly limited to the measure of his character, his moral and mental means.

It must be admitted that communism does imply a total negation of competition, according to its maxim, "To every man according to his need, from every man according to his power." But it is too late in the nineteenth century for intelligent men to confound two systems not alike even in their moral aspirations, much less in their economic proposals. Socialism is to-day as much a science as definition and precision of statement can make any character of institutions. It teaches that a system of industry, which is in fact collective in its dependence and interdependence of parts, should be collective in its responsibilities, collective in its powers, and collective in the distribution of its benefits. These ends can be secured only by the same social ownershp of the system of industry which the people of this country have long ago inaugurated as to their government itself. They own that government in theory, at least, body, root, and branch. In fact, their reasoning in behalf of republican institutions is identical with ours in favor of a democratic system of industry. The only difference in the transition from privately owned governments (aristocracies and monarchies) to democratic governments, and that of private capital to social capital, is that the former must antedate. The principle is identical. The object is the same,

namely, the amelioration of men from the abuses of irresponsible power. And what prodigies of power the captains of industry have now become! Not a king among the Stuarts or the Hanovers has held such powers. And yet, in the industrial government of the enlightened world to-day, these powers are above every government, imperial or republican, far above the puny power of the masses, and in the hands of stock gamblers who, under the glamour of a rising or falling market, can not govern their own miserable passions.

I do not hope to change any views you may have deliberately reached, even on a subject which calls for frequent modification of the smaller details of its statement. But I hope I may ask you to correct in any way you may find convenient my conclusions if they seem wrong in respect to the relation of socialism with competition. The advance of socialism in the last five years throughout the *enlightened world* has been so great as to call for careful examination by all thinkers, so that if its teachings are wise and just they may be hastened to power, otherwise that they may be insured their merited fall.

Very sincerely yours,

DAVID J. LEWIS.

CUMBERLAND, MD., *July 15, 1898.*

Editor's Table.

SOCIALISM AND COMPETITION.

WE print in our correspondence column a courteous letter from Mr. David J. Lewis, of Cumberland, Md., who writes to say that, though a socialist, he approves of the position taken in our recent article on Competition and the Golden Rule, and that modern socialism, by which he understands the replacing of privately owned by publicly owned capital in the production of wealth, does not involve the cessation of competition. This, of course, is a question which we did not raise in the article referred to: we merely sought to meet the *a priori* objection to competition contained in the declaration often made that, if the Golden Rule is right, competition must be wrong. We are quite prepared to believe that competition will prove to be an indestructible element of human life, and that, though temporarily driven out by the pitchfork of socialistic legislation, it will, like Nature, fly back at the first chance.

Our correspondent's position, we confess, is one which we find it a little difficult to understand. He speaks of the social ownership of capital and the elimination of rent, interest, and profit, but says that these things would not do away with the wage system, or with the gaining of immensely more money by the more capable members of the community than by the less capable. There will be Edisons under the new system who, just as at present, will have vast advantages over their "poorly equipped competitors." Only—this we infer—they will have to work strictly for wages, and can never exploit their own inventions or become employers of labor. When the people take possession of the private capital now employed in industry and commerce, they will simply complete that emancipation, the first step in which was to displace monarchical and aristocratic by democratic institutions. Henceforth capital will never compete with capital, because all capital will be under one ownership; but individuals will go on competing with individuals for the largest shares obtainable from the common fund.

All this may make a harmonious system in the mind of our correspondent, but to us it presents great incongruities. We find it difficult to realize the Edisons in harness; and we fear it might not be easy to persuade the "poorly equipped moral,

mental, or physical competitors" to whom he refers to be satisfied with relatively inferior wages. When all are fed from the same trough, it will require much grace to be content with less than an average share. But perhaps grace will much more abound under the socialistic *régime* than it does amid the bustle and strife of our present system. There are, however, some special points to be noticed in connection with our correspondent's theory. We can not see that the parallel between the establishment of democracy and the suppression of private capital holds good. A government of any kind is either carried on in the interest of the people or it is not. If it is, and if it has not yet assumed a democratic form, the people are entitled, when the proper moment has come, to say: "We are quite capable of managing this business of government ourselves, through representatives whom we shall freely elect; and we release you—kings, potentates, nobles—from all further responsibility on our behalf." If it is not carried on in the interest of the people, then it is a mere tyranny, against which the people have a right to rebel the moment they feel strong enough to do so. In seizing the government they are seizing that which can not belong by right to any private individual. The case is altogether different when it comes to seizing capital. Without aiming at a too scientific definition, we may say that capital is the unexpended portion of each person's earnings. He who takes that takes what the individual has a natural right to hold and to employ. It is not customary to argue that, because the time comes when a young man assumes the direction of his own actions, and no longer trusts implicitly to paternal advice, he should, to complete his emancipation, proceed to possess himself of the old gentleman's worldly means. Yet socialists tell us that political emancipation should logically be followed by the appropriation of private capital.

To take another point. There is waste of capital involved, no doubt, in many forms of competition; but the *régime* of competition, or, as we would say, of freedom, is on the whole favorable in the highest degree both to the production and to the conservation of capital; seeing that the interests and the energies of all are constantly engaged for both objects. To be sure, there is clashing of interests here and there; but every one is on the alert to do his best for that portion of capital which he individually holds; and, as a result, capital is continually on the increase. The proof, if proof were needed, is found in the fact that the rate of interest tends continually to fall while the rate of wages tends to rise. Is it at all certain that under a socialistic management of capital the same phenomena would be witnessed? Is it certain that the energy, activity, and resource of the workers of the community would stand at the same level at which they do to-day? He who says that they would, affirms that of which he has no knowledge, and which the experience of the world so far can not be said to render probable.

What governments do under present conditions is to take from the citizens a portion of their earnings to expend upon works in which the interest of all is concerned, and which require to be carried out with absolute uniformity of principle and method. Foremost in importance among the necessary works of government is the administration of justice, including the protection of life and property. Law must be the voice of the community; individuals can not be left to make it or apply it

for themselves. Closely following upon the necessity for common laws is the necessity for common action in various matters pertaining to the good order and health of the community. A true test of that which belongs to the sphere of government and that which belongs to the sphere of individual action lies in the essentially restrictive character of governmental action. Government says, "Thou shalt not——"; but when we come to the proper sphere of individual liberty, we find numberless openings for positive constructive action. Government does not say, "Thou shalt go to church"; but individual enterprise gives us churches to go to if we feel so disposed. Even in the matter of education the mandate of Government is not so much "Thou shalt be educated" as "Thou shalt *not* through ignorance be a menace to society." If the Government says, "Thou shalt be vaccinated," the real meaning is, "Thou shalt *not* become a means of spreading infectious disease."

It is quite true that the state in our time manifests a disposition to betake itself to many lines of constructive work; but how far, in doing so, it makes a profitable use of the capital it disposes of—capital taken in taxes from the free industry of the country—we are not prepared to say; though we doubt much whether in any case the balance sheet is a favorable one. With large means at their command it is easy for public functionaries to show material results of a more or less imposing kind; but what we do not see is the amount of individual initiative and resourcefulness which the rival activity of the state obscures and suppresses. The post office is often pointed to as a very beneficent form of state activity; but it is certain that it is not an illustration of the profitable employment of capital. Were all the functions of modern life carried on upon similar financial principles, there would be much more poverty in the land than there is. The free industry of the country amasses capital upon which the Government draws, and, so long as industry is in the main free, the Government can afford to commit many follies without inflicting fatal evil on the community; but tie up industry in socialistic bonds, and many singular and undesirable results might follow.

We do not feel much encouraged, therefore, by the assurance our correspondent gives that, under socialism, individual competition would still flourish, and that exceptional talents would still reap exceptional rewards. We are not specially interested in competition as such, nor do we sympathize any more with the man of exceptional than with the man of ordinary ability. What we are interested in is the freedom of the individual citizen to use, and develop, and profit by, and render profitable to others, such natural faculties as he may possess to the utmost extent. What we are also interested in is the free development of the moral life of the community, under the action of a growing sense of responsibility of man to man. We do not want stereotyped characters or enforced virtues; we want men to grow into a recognition of their duties to one another, and we believe they will do so if the political power will only keep its hands off matters that do not belong to it. There is no agency more effectual in repressing the better instincts of the human heart than compulsion or the threat of compulsion; and the air to-day is full of threats of compulsion. We are not doing good or getting good fast enough, and a lot of extra-good people—as they think themselves—are going to help forward our moral

education by various legislative measures. Now the man who is going to be made good by an act of the legislature does not in general like the prospect, and he is very apt to harden his heart against the operation. That is why the more truly moral the law is, the more it is apt to fail of its object. As to capital, the possession of it by an individual is a great responsibility, and one that for the most part is not as fully recognized as it ought to be; but we should much prefer to trust to a growing moralization of public opinion in the matter than rashly to transfer all capital to the state, and rely for its fructification and wise distribution on the disinterested statesmanship of our representative bodies.

LIVING AND DYING NATIONS.

CLOSE inspection of Lord Salisbury's deliverance before the Primrose League on living and dying nations discloses a want of scientific precision. Describing the living nations, he said: "You have great countries of enormous power, growing in power every year, growing in wealth, growing in dominion, growing in the perfection of their organization. Railways have given them the power to concentrate upon any one point the whole military force of their population, and to assemble armies of a magnitude and power never dreamed of in the generations that have gone by. Science has placed in the hands of those armies weapons ever growing in the efficiency of their destruction, and therefore adding to the power, fearfully to the power, of those who have the opportunity of using them." Referring to the dying nations, he said: "In these states disorganization and decay are advancing almost as fast as concentration and increasing power are advancing in the living nations that stand beside them. Decade after decade they are weaker, poorer, and less provided with leading men or institutions in which they can trust. The society—and official society, the administration—is a mass of corruption, so that there is no firm ground on which any hope of reform or restoration could be based, and in their various degrees they are presenting a terrible picture to the more enlightened portion of the world." The British premier himself did not cite any examples in illustration of this classification. His commentators, however, exercised no such restraint. They were sure that among the dying nations we should place Turkey, China, and Spain, and among the living, that is, the growing—Russia, Germany, France, England, and the United States. But, like the classification of Lord Salisbury, such a list confounds the growth of military power with the growth of industrial and moral power. It attributes to dying nations traits characteristic of living nations, and, *vice versa*, traits attributed to living nations belong to dying nations.

But before more trustworthy tests can be applied it is needful to ascertain what constitutes growth and what constitutes death. Happily, the law of evolution offers an easy solution of this question. Without being too precise, growth, according to that law, signifies, first, an increase of mass; and, second, such a rearrangement of matter and motion as to effect a more perfect adjustment of means to ends. But the attainment of this object involves a change of the mass from a homogeneous condition to a heterogeneous one and from an indefiniteness and incoherency of parts to definiteness and coherency. Decay, on the other hand, means a loss of mass, and such a rearrange-

ment of matter and motion as to produce a diminished adaptation of means to ends. With the change from heterogeneity to homogeneity, the parts become less and less definite and coherent. If these abstract terms of general evolution be converted into the concrete terms of social evolution, we get a scientific conception of Lord Salisbury's taking phrase. A growing society is one where the population is increasing in numbers, and each individual finds the conditions of existence constantly bettered. The simple relations of primitive life are changed into the complex relations of civilized life. All the social organs required to meet every want and taste spring into existence. Instead of being limited to plunder, or the chase, or pastoral pursuits, human activity assumes the countless forms of modern industry. But while society is thus becoming more heterogeneous, its parts are becoming more definite and coherent. To increase the efficiency of their labor, people devote themselves to some particular pursuit. At the same time they become to an increasing degree dependent upon one another; for, in order to get what they want, they must exchange with one another the products of their toil. Where evolution is thus permitted to operate freely, the most perfect adaptation of society to the conditions of existence takes place, and the greatest possible degree of happiness is attained. In a decadent society this process is reversed. Because of the tyranny of custom, which forbids social change and adaptation, or in consequence of the Government's usurpation of functions that do not belong to it, which has the same fatal effect, people cease to be free to do as they please, and to live the life that seems to them best. Robbed by the crushing taxation necessary to sustain the bureaucratic parasites that enforce the rules and regulations throttling industry, they become discouraged, and, abandoning the honest pursuits of peace, they become beggars or brigands. Under these conditions, society becomes disorganized, and eventually disappears. As in Mesopotamia and other parts of Asia, once rich and populous, the country reverts to solitude.

We are now in a position to see that modern societies are not in a condition that permits of Lord Salisbury's easy classification. Decadent as some of them are in many respects, it is by no means certain that they have reached the limits of evolution and entered upon a career of dissolution. Evolving with great rapidity as others are, it is by no means certain that they are not pursuing a course that will bring them to ruin. Turkey is probably the most decadent of all. But it is not because of her loss of territory ; it is because of her rigid social structure, her incapacity to adopt the ideas and institutions of progressive societies, and her failure to protect her people from the rapacity of officials and brigands. Although less militant, China suffers in a like manner. Besides the tyranny of custom, which represses the activity of the individual and thwarts social evolution, there is the tyranny of a powerful and corrupt bureaucracy. In consequence of both, ideas and institutions are antiquated, industry is in a primitive state, and the rewards of toil are very small. Nevertheless there are signs of growth. Railroads and telegraphs are being introduced, quickening the circulation of products and ideas. A movement is afoot to improve industrial methods and the administration of the government. Compared with Turkey and China, Spain is a progressive state. Within the last century

a considerable increase in population has occurred. During the same period, freedom, the essential condition of growth, has made many conquests. The Inquisition has been abolished. Religious toleration, with a free press and free speech, has been established. The right of association has been recognized. The most onerous and odious of the industrial regulations of centuries of despotism have been repealed. Indeed, the conditions of social evolution are more favorable in Spain than in any of the great continental countries. To be sure, she has, like Russia, Germany, France, and Italy, a powerful and corrupt bureaucratic system; but she does not have to bear the burdens of an immense standing army, nor is she subjected to its centralizing and demoralizing influences. Unlike Russia and Germany, she does not have a ruler that seeks to impose his will upon her people, and to force them to live in disregard of their wishes. The bitter class hatreds born of militancy do not exist in Spain that exist in France. Although the Spanish population is poor, it has not, as in Italy, been driven by misgovernment and destitution to brigandage and insurrection.

While it can not be denied that England and the United States are nations in a state of rapid evolution, their evolution is not taking place in the way usually supposed. It is not by acquisitions of foreign territory that nations grow great and powerful. Such acquisitions may be signs of decay, and, like certain tumors, hasten death. If they are due to the militant impulse—the progenitor of the new colonies of France and Germany—and require standing armies to keep them in subjection, causing a heavy drain upon the resources of the mother country, they are a source of weakness. What constitutes the greatness of England and the United States is the increase of their populations, the capacity of these populations for private initiative, the development of their resources, the discovery of new methods of production, the improvement of old methods of distribution, the generous rewards bestowed upon toil, the deference shown for the rights of others—in a word, the more perfect adjustment of life to the conditions of existence. Were it not for a change of policy that has occurred in both countries, this adjustment would continue until the soil had been forced to yield the largest product and the population had reached its maximum in numbers, industrial skill, and social amelioration. But this change is destroying freedom; it is checking social mobility; it is increasing the functions and regulations of government; it is adding to the army of militant and bureaucratic parasites; it is preventing labor from receiving its highest reward and the individual from attaining his greatest happiness; to sum up, it is bringing about just such a state as is deplored in Turkey and China and working the ruin of Italy and France. The money taken from the individual and spent in ways not his own has reached an enormous sum, and is constantly increasing. The discontent and animosity growing out of this aggression are increasing in a like degree, taking the form of labor insurrections, agitations for the depreciation of the currency, and the robbery of the rich under the cover of inquisitorial and confiscatory taxes in support of schemes for the benefit of the poor. In the United States more particularly, there has been a rapid development of the militant spirit, which demands the adoption of an imperial policy of aggression and colonial expansion,

the construction of a great navy, the organization of a large standing army, and the erection of extensive coast fortifications. But unproductive activity of this kind will make life harder, provoke more discontent, and possibly lead to the same outbursts that have taken place in Italy. Here, as elsewhere, such occurrences will be the opportunity for the military despot, and with him will come the repression that makes further social evolution difficult or impossible.

Scientific Literature.

SPECIAL BOOKS.

M. LOUIS PROAL'S *Political Crime*,* the best volume of the Criminology Series, is a needful contribution to the study of sociology. Few people have any adequate conception of the amount of crime connected with politics. Still fewer appreciate the far-reaching and deplorable consequences of that crime. The reason is plain. An idea altogether too prevalent is that in politics a course of conduct may be pursued that would be regarded as highly immoral and reprehensible in other forms of human activity. In the interest of the public welfare it is permissible to practice a code of ethics that differs in no wise from that practiced in war—a code that found its most perfect and odious exposition in Machiavelli's Prince. M. Proal's book is an energetic and scholarly protest against this view. "Craft and violence," he says, "may score ephemeral successes, but they do not assure the greatness and prosperity of a country. The successes achieved by an immoral policy are not lasting; sooner or later nations, like individuals, politicians just as private persons, are punished for the evil or rewarded for the good they do." Again he says: "If a lengthy period be examined, one is struck in a general way by the fact that failure attends an immoral policy. A politician, face to face with a serious difficulty, thinks recourse to an unjust expedient of immediate utility the simplest mode of escape from it, but the future is not slow to teach him the drawbacks of injustice." Never was there a time in our own history when it was more important that such a lesson be learned, not only by politicians but by philanthropists of the socialistic order, and scrupulously observed.

At the outset M. Proal exposes the falsity of the current notion that the philosophy invented to justify this form of crime originated with Machiavelli. "Politics," he says, "did not await the advent of Machiavelli to become shifty, violent, and sanguinary. Statesmen did not need the lessons of the Italian writer to teach them to lie, to proscribe their adversaries, and confiscate their belongings. The desire to rule, the exercise of authority," he adds, explaining the cause of political crime and exposing its kinship with war, "teach fraud and violence." Even so great a philosopher as Plato and so enlightened a statesman as Canning approved Machiavellian principles. "It seems to me," wrote the Greek in his Politics, "that our magistrates will often be obliged to have recourse to lying and deceit in the interest of their fellow-citizens, and we have declared elsewhere that a lie

* Political Crime. By Louis Proal. New York: D. Appleton and Company. Pp. 335. Price, $1.50.

is useful when it is employed as a remedy—and rightly so." Referring to the unjust laws promulgated against the Catholics under James I, the Englishman says, "Unjust as these stipulations were, the safety of the state rendered them necessary." It is only when such principles are found in the mouth of a terrorist like Marat that their infamous character is fully realized. "Before this supreme law," he wrote, alluding to "the safety of the people," and in justification of the crimes that he and his partisans committed, "all other laws should be as naught. To save the country all means are good, all means are just, all means are meritorious."

M. Proal's exposition of the direful fruits of such a political philosophy is scholarly and complete. Of the eleven chapters in his book, nine of them are devoted to a citation of some of the more striking crimes of ancient and modern history, particularly that of France, committed to insure "the safety of the people." They are of great interest and value, including as they do Political Assassination and Tyrannicide, Anarchism, Political Hatreds, Political Hypocrisy, Political Spoliation, Corruption among Politicians, Electoral Corruption, The Corruption of Law and Justice by Politics, and The Corruption of Morals by Politics. The cumulative effect of this mass of facts is irresistible. They make clear, as nothing else can, how politics may poison the whole social fabric—how, indeed, it may produce effects wholly unexpected. "Bad political morals," says M. Proal, "spread to the people; they accustom it to deceit, cruelty, and injustice, and they diminish its loathing for evil. The immorality of those who govern infects sooner or later those who are governed." He tells us that "the Terror rendered cruel even those who fought against it, and it left its mark upon the youth of the higher classes." He tells us further that "the triumph of might makes people lose confidence in right, and destroys their faith in justice." Not only do immoral politics lead to cruelty and greed, but, as M. Proal shows by a number of examples, to intemperance, gluttony, and even sexual laxity. He shows, finally, that by "the creation of privileges" they produce changes in the structure of society. "Undoing the work of God, who gave the same rights to all men," he says, "they have created inequality in the matter of civil and political rights, they have altered the true mutual relations of men, and they have established inequality even in respect to justice."

The only important lesson taught by this demoralization is not the necessity of a scrupulous observance of a rigid code of ethics in political action. Hardly less important is the lesson that all writers and public speakers should possess sound judgment. "I believe," says M. Proal, "that disordered ideas produce moral disorder, that a false thesis may call forth an infinite number of bad actions, that a sophism is often more dangerous to society than a crime." As judge of the Court of Appeal at Aix, before which political criminals had been tried, he had ample opportunity to confirm this view. Reprobation too severe can not, therefore, be visited upon such a writer as M. Renan, who says, "It is better that a people should be immoral than that it should be fanatical." Nor should approval ever be bestowed upon works in glorification of revolution or other forms of violence. They are text-books of political crime. "The historian," said Lamartine, who, with Thiers and Louis Blanc, had been guilty of the offense, "who furnishes crime with an excuse and cruelty with a fallacious pretext, paves the way unawares for future indulgence toward the imitators of these crimes." As to certain newspapers and speakers, with which

the United States as well as France is cursed, M. Proal says that "like corrosive acids," they "destroy all they touch," and "like alcohol," they "inflame the blood, agitate the nerves, sear the brain, and dry up the heart." Until the truth with regard to the facts of history and the questions of the day is set forth scrupulously, it is needless to expect an end of political crime.

PROFESSOR *Packard's* elaborate *Text-Book of Entomology** was prepared with the wants of both the student and teacher in mind, and the book has grown in part out of the writer's experience in class work. In instructing small classes in the anatomy and metamorphoses of insects, it was felt that the mere dissection and drawing of a few types comprising some of our common insects were not sufficient for broad, thorough work. Without depreciating the importance of laboratory study, it needed to be supplemented by frequent explanations or formal lectures, with collateral reading by the student in some general treatise in structural and developmental entomology. The present text has been prepared to serve this purpose, giving, of course, with much greater fullness and detail what was roughly outlined in the class work. The aim has been to afford a broad foundation for future more special research by any one who may want to carry on the study of some groups of insects, or to extend in any special direction our present knowledge of insect morphology and growth. The number of insects in orders, families, genera, and species (they forming about four fifths of the animal kingdom), their habits and transformations, and the variety of ways in which they affect human interests, are given as reasons why they have attracted more attention from students than any other classes of animals. They are represented as perhaps more complicated in structure than any other animals. Having defined their general position, Professor Packard describes the chief differences between them and their neighbors—the crustaceans, trilobites, spiders, and others. Their morphology and physiology are considered in respect to their external and internal anatomy, under which head all their parts are described with their several relations and functions. The second part of the book is devoted to the embryology of insects, and the third to their metamorphoses. Copious bibliographical lists are appended to each of the departments, arranged by dates so as to give an idea of the historical development of the subject. A full index completes the volume.

GENERAL NOTICES.

IN Dr. *Oppenheim's* book on *The Development of the Child*,† the subject is treated in a philosophical spirit. The author makes a serious study of the factors that contribute to the child's development and the formation of his character, and seeks to find how they may be most advantageously treated and cultivated so as to secure the best results. He makes much less account of heredity than do most authors—reducing it, in fact, to its lowest terms—and gives special predominance to the environment and nutrition. "There is not enough of conviction in the minds of parents and guardians," he says, "that the responsibility of their children's acts, good and bad, rests upon their older shoulders; that the final outcome of their chil-

* A Text-Book of Entomology, including the Anatomy, Physiology, Embryology, and Metamorphoses of Insects. For Use in Agricultural and Technical Schools and Colleges, as well as by the Working Entomologist. By Alpheus S. Packard. New York: The Macmillan Company. Pp. 727. Price, $4.50.

† The Development of the Child. By Nathan Oppenheim. New York: The Macmillan Company. Pp. 296. Price, $1.25.

dren's lives depends almost entirely upon the influences, the nutrition, the environment which the authority of the parents and guardians provides." He begins by pointing out and presenting the differences in the constitution of the child and the adult, so as to show "that an infant's development is not a rigidly immovable process, that it progresses slowly and irregularly, and that during its course the child is in so unstable a condition that no strain should be put upon his faculties." The comparative importance of heredity and environment is next considered, with the result that we have already indicated. The methods of the primary school are sharply criticised, and the rule is prescribed that "every subject should, in its claim for a place in the curriculum, be judged by its adaptability to the child's growth," and hints are offered toward a better method. Reasons are adduced and enforced with illustrations from children's words, why religious instruction, as usually applied, is not adapted to the child's mind and can hardly convey correct ideas. In a similar spirit the author discusses The Value of the Child as a Witness in Suits at Law; The Development of the Child Criminal; The Genius and the Defective; and Institutional Life in the Development of the Child. In the final chapter, The Profession of Maternity, the importance is emphasized of making training for the duties of motherhood a predominant feature in the education of women.

The twelve essays constituting Prof. *Josiah Royce's* volume of *Studies of Good and Evil*,* though seemingly varied in topic and as to the occasions on which they were first presented, represent together what the author calls a type of post-Kantian idealism. Their appeal is to those readers to whom studies of more familiar issues in the light of philosophical considerations are more enlightening than fundamental metaphysical arguments. Believing that the student should be relatively independent as to the manner in which he reaches his conclusions and as regards the kind of insight he seeks to impart to his readers, Professor Royce hopes that his papers may serve to indicate in what sense the philosophical theses he has to maintain possess a genuinely individual character. They are all, directly or indirectly, contributions to the comprehension of the ethical aspects of the universe, and are of various relations to technical philosophical issues. Four of them are essays in literary and philosophical criticism; one is directly concerned with the effect of the knowledge of good and evil upon the character of the individual man; one is a contribution to the metaphysical problem of evil in its most general sense; five, while dealing with metaphysical and psychological problems connected with the nature and relationships of our human type of consciousness, are somewhat more indirect contributions to the ethical interpretation of our place in the universe. One is a historical study of a concrete conflict between good and evil tendencies in early California life. The first paper, The Problem of Job, presents the author's theory of evil. The second is a psychological study of a personal experience of John Bunyan. The third paper, on Tennyson and Pessimism, bears on a theory of the relation between good and evil; and another general aspect of that relation is discussed in the fourth paper. These studies prepare the way for the metaphysical issue of the ethical interpretation of reality; and the problem of the general relation between natural law and the demands of ethics is stated in the fifth essay; while the sixth states the general case for an idealistic interpretation of the universe in its relations to self-consciousness. The question of what finite consciousness with all its burdens of good and evil may be and mean is treated in the seventh and eighth essays; and the discussion of consciousness is continued in the ninth. The last three papers concern more special issues, and relate to Meister Eckhart, the German mystic of the thirteenth century; the squatter riot of 1850 in Sacramento; and the late French philosophical critic, Jean Marie Guyau.

Mr. *MacEwan's Essentials of Argumentation* * is the outgrowth of a dozen years' experience with classes in an agricultural col-

* Studies of Good and Evil. A Series of Essays upon Problems of Philosophy and of Life. By Josiah Royce. New York: D. Appleton and Company. Pp. 384. Price, $1.50.

* The Essentials of Argumentation. By Elias J. MacEwan. Boston: D. C. Heath & Co. Pp. 412. Price, $1.12.

lege. The time for literary training being limited in such an institution, a course had to be provided that would be most helpful to students who had not time to study all the niceties of literary expression, and could, at best, master only the elementary principles of rhetoric and make themselves familiar, in a general way, with the ordinary forms of prose composition. Their work would require proficiency in description, clear and sound reasoning, and the cogent presentation of what they would want others to accept as true. Adapting his course to this condition, the author made it largely one in argumentation, with the result of a more rapid development of the student's power of reflection and greater facility and accuracy of expression. The present book follows the plan of the course thus described. While adapting his work largely to the practical questions of the day, the author has inserted model examples of argument from every source, whether new or old, affording illustrations that would illustrate. Famous passages from Webster and Burke, from Shakespeare's oratory, and from Huxley's addresses are accompanied by minute analyses of their parts, qualities, and points; and a list of more than two hundred propositions for argument or debate, and a glossary of terms, are given.

La Industria Agricola is a new agricultural paper started at Caracas, Venezuela, with Señor Guillermo Delgado Palacios as editor. Of the thirty-two pages of the first number six are devoted to the exposition of the purposes of the magazine and the bearing of science on agriculture; five to the agricultural bureaus and societies of Venezuela; ten to the agricultural staples of the country, wheat, sugar cane, and corn; two to agricultural items from the United States; and the rest to industrial novelties and miscellaneous articles.

L'Intermédiaire des Biologistes (The Biologists' Intermediary) is a useful semimonthly international organ of zoölogy, botany, physiology, and psychology, published in Paris under the editorial direction of MM. Alfred Binet and Victor Henri, with numerous colaborers of equal scientific standing, which has just completed its first year. The number before us has as its leading original articles papers on the sexuality of aphides, by E. G. Balbini, and on the Colorability of Living Protoplasm, by F. Henneguy; and these are followed by two pages seeking answers from correspondents, seven pages of answers to previous questions—the notes and query feature being one of the most prominent of the publication—and classified summaries of the biological contents of periodicals. Price, 12 francs ($2.50) a year.

The Philosophy of the Humanities includes three addresses delivered on separate occasions and to different bodies by Thomas Fitzhugh, professor of Latin in the University of Texas. They discuss the evolution of classic culture and its pedagogic treatment, and inquire into the philosophic basis of the humanities. The subjects are The Evolution of Culture, The Pedagogic Aspect of Culture Evolution; Organization of the Latin Humanities in College, and Organization of the Latin Humanities in Secondary Education. The author is a sturdy advocate of the study of Latin. (University of Chicago press.)

A *Bibliography and Index* of North American Geology, Palæontology, and Mineralogy for 1892 and 1893, compiled by *Fred Boughton Weeks*, and constituting Bulletin No. 130 of the United States Geological Survey, contains 1,121 titles. The index is complete and elaborate, classified by States and main subjects, and arranged alphabetically throughout. A list of publications examined is appended.

In the comparative study of *L'Évolution régressive en Biologie et en Sociologie* (Regressive Evolution in Biology and Sociology), the ground is taken by the authors (MM. *Jean Demoor*, *Jean Massart*, and *Émile Vandervelde*) that the word evolution does not in itself imply either progression or regression, but designates all transformations, whether favorable or unfavorable, and they have applied themselves to the study of the latter kind. They have conducted the results of their several special researches in the biological and social fields so as to show how the regressive feature is manifested in both, and that every transformation involves a loss as well as a gain; that "regression is not an accident of evolution, but is the inverse of progressive evolution, the necessary complement of all transformation, organic or

social." When we study any transformation whatever we may hit upon, taking variations as they come, we find that as a consequence of it some parts of the structure become useless, and their gradual elimination ensues, as in the interest of the organization itself, considered as a whole. The working of this principle is considered in its various aspects in the worlds of organic life and society. (Paris: Félix Alcan, Bibliothèque Scientifique Internationale.)

The *Bibliography of the Anthropology of Peru*, published by *George A. Dorsey* in the Anthropological Series of the Papers of the Field Columbian Museum, Chicago, shows that the list of books and papers relating to the subject is a very considerable one and would of itself furnish a respectable library; yet the compiler does not pretend that it is exhaustive. He has only done his best with the material accessible to him. His aim has been, so far as possible, to cover the whole ground, and to include such works from the earliest times down to the present day as treat of the modern Indians and of the Peruvians of ancient times, and to include all known editions of the early Spanish authorities. Interest and value are added to his work by the short biographical sketches he furnishes of about fifty of the more important authors of the early Spanish times. Mr. Dorsey hopes to follow this work with an index by subjects and topics.

The eleventh volume of the Annals of the Argentine Meteorological Office (*Anales de la Officina Meteorológica Argentina*), Walter G. Davis, director, covers the observations of the year 1893. It includes elaborate tables similar to those which have characterized previous volumes of the *Anales*, with climatic details, at the stations of San Jorge (Cordoba), Isla de los Estados, Chos-Malal, Paramillo de Uspallata, on Potro Muerto; with, in addition, summaries of monthly observations from October, 1895, till December, 1896, at Isla de los Estados, and from May till August, 1896, at Chos-Malal. Twelve new stations were established during the year covered by the report. Voluntary observations of the principal meteorological elements were received from thirty-six points, and of rain from seventy-three. Reports of observations made six times a day were received from Concepcion, Paraguay. Stations have been established outside of the republic, near its frontiers, in cases where suitable points could not be found in the same latitudes within the national territory, whereby important data have been secured that would otherwise have been missed.

PUBLICATIONS RECEIVED.

Adams, C. J. The Matterhorn Head and other Poems. Rossville, Staten Island, New York: The Bureau of Biophilism. Pp. 20.

Agricultural Experiment Stations. Bulletins and Reports. Michigan State Agricultural College: Elementary Science Series. No. 1. Beans and Peas before and after Sprouting; No. 2. Wheat and Buckwheat, ditto; Seeds of Clover and Timothy, ditto; Observations on the Leaves of Clovers at Different Times of the Day. All by W. J. Beal. Pp. 8 each; Report of the Botanical Department of Michigan State Agricultural College. By W. J. Beal. Pp. 24; Michigan Monthly Bureau of Vital Statistics, May, 1898. Pp. 20.—New Jersey: No. 129. Asparagus Rust. Pp. 20.—New York: Popular Editions of No. 139. Plant Lice; No. 140. Wood Ashes not an Apple-Scab Preventive; No. 141. Some Results in Stock Feeding. Pp. 6 each; Bulletin No. 142. Director's Report for 1897. Pp. 24.—United States Department of Agriculture: Farmer's Bulletin No. 74. Milk as Food. Pp. 40; Miscellaneous No. 15. Changes in the Rates of Charge of Railway and other Transportation Services. By H. C. Newcomb. Pp. 80.—West Virginia: No. 52. Strawberries. By L. C. Corbett. Pp. 24.

American Catholic Historical Society of Philadelphia. Record. Quarterly. Vol. IX. No. 2. June, 1898. Pp. 180. 50 cents; $2 a year.

Aveling, Eleanor Marx. History of the Commune of 1871. Translated from the French of Lissagaray. New York: International Publishing Company, 28 Duane Street. Pp. 500.

Baldwin, J. M. The Story of the Mind. (Library of Useful Stories.) New York: D. Appleton and Company. Pp. 236. 40 cents.

Barnes, C. R. Plant Life, considered with Special Reference to Form and Function. New York: Henry Holt & Co. Pp. 478. $1.12.

Bulletins, Reports, and Proceedings. American Museum of Natural History: Memoirs, Anthropological. The Jesup North Pacific Expedition. Facial Paintings of the Indians of North British Columbia. By Franz Boas. Pp. 24, with 5 plates.—Baltimore Medical College: Annual Announcement and Catalogue, 1898–'99. Pp. 32.—Indiana: Report on Geology and Mineral Resources, 1897. Pp. 1197.—Johns Hopkins University: General Statements as to the Courses of Instruction. Pp. 20.—Minnesota: Botanical Studies. Conway MacMillan, State Botanist. Second Series. Part I. Pp. 68.—Museum of Comparative Zoölogy at Harvard College: The Geological History of the Isthmus of Panama and Portions of Costa Rica. By Robert T. Hill. Pp. 140, with 13 plates.—Torrey Botanical Club: Bulletin. July, 1898. L. M. Underwood, Editor. Pp. 60. $2 a year.—Yale University Observatory: Report of the Managers for 1897–'98. Pp. 22.—United States Department of Labor: Bulletin. July, 1898. Economic Aspects of the Liquor Problem and other Subjects. Pp. 156.—United States Commissioner of Education: Report for 1896–'97. Pp. 1136.—University Geological Survey of Kansas: Vol. IV. Paleontology. Pp. 594, with plates.

Carus-Wilson, C. A. Electro-Dynamics. The Direct-Current Motor. New York: Longmans, Green & Co. Pp. 298. $1.75.

Congdon, E. A. A Brief Course in Qualitative Analysis. New York: Henry Holt & Co. Pp. 62. 60 cents.

Detmer, Dr. W., and Moor, S. A. Practical Plant Physiology. London: Swan, Sonnenschein & Co. New York: The Macmillan Company. Pp. 535. $3.

Groos, Karl. The Play of Animals. Translated, with the author's co-operation, by Elizabeth L. Baldwin. With a Preface and Appendix by J. Mark Baldwin. New York: D. Appleton and Company. Pp. 341. $1.75.

Harris, Edith T. The Story of Rob Roy, by Sir Walter Scott, condensed for Home and School Reading. (Appletons' Home-Reading Books.) New York: D. Appleton and Company. Pp. 306. 60 cents.

Keyser, L. S. News from the Birds. (Appletons' Home-Reading Books.) New York: D. Appleton and Company. Pp. 229.

Mills, Wesley. The Nature and Development of Animal Intelligence. New York: The Macmillan Company. Pp. 307. $2.

Mutual Boiler Insurance Company, Boston. Cost of Boiler-Room Labor. Bad Shoveling. Pp. 201.—Comparative Steam-making Values of Coals used in the Northeastern States. By R. S. Hale. Pp. 9.—Tests of Steam-pipe and Boiler Coverings. By C. L. Norton.

Overton, Frank. Applied Physiology, including the Effects of Alcohol and Narcotics. Primary Grade. Pp. 128.—Intermediate. Pp. 188.—Advanced. Pp. 432. American Book Company.

Pyle, Howard. The Divinity of Labor. (Commencement Address.) Wilmington, Del. Pp. 12.

Redway, Jacques W., and Hinman, Russell. Natural Advanced Geography. American Book Company. Pp. 160.

Reprints. Lyons, Florence M.: A Contribution to the Life History of Euphorbia Corollata. Pp. 8, with plates.—Hester, C. A., M. D.: The Pathology of Uræmic Intoxications. Pp. 20.—Mercer, H. C.: A New Investigation of Man's Antiquity at Trenton. Pp. 20.—Merck's Digest: No. 16. Tannalbin (astringent). Pp. 8; No. 18. Aqua Levico (alterant tonic). Pp. 4; No. 21. Ichthalbin (alterant, antiphlogistic, and assimilative). Pp. 8. Merck & Co., New York.—Rotch, A. L.: The International Aëronautic Conferences. Pp. 8.—Silenker, M. A., M. D.: Clinical Observations of a New Antipyretic. Pp. 4.—Smith, W. R.: A Contribution to the Life History of the Pontederiaceæ. Pp. 16, with plates.—Wadsworth, M. E.: Zirkelite. P. 1; The Elective System in Engineering Colleges. Pp. 39; Mineral Plates in Converging Polarized Light with the Petrological Microscope. Pp. 8; The Elective System in Technological Schools. Pp. 14; Some Statistics of Engineering Education. Pp. 24; The Michigan College of Mines. Pp. 16; The Origin and Mode of Occurrence of the Lake Superior Copper Deposits. Pp. 28.

Ripley, F. H., and Tapper, Thomas. A Short Course in Natural Music. Book I. Elementary. American Book Company. Pp. 144. 35 cents.

Troeger, J. N. Harold's Rambles. (Appletons' Home-Reading Books. Nature Study Readers.) New York: D. Appleton and Company. Pp. 155. 40 cents.

Fragments of Science.

International Language Study.—An interesting and comparatively new scheme for the study of foreign languages is described by E. H. Magill, ex-president of Swarthmore College, in a recent issue of The Kindergarten Magazine. "How these foreign languages can best be taught in our schools and colleges is a question which has received much attention at the hands of experienced educators of this generation." Some have contended that no attempt should be made to teach the student to converse or write in the foreign language, but that he should simply learn enough of grammatical form to enable him, when he has obtained a vocabulary, to read the written language easily. In fact, this opinion has been very generally held by educators. The method of instruction about to be described, however, seems in a fair way to change this feeling into one favoring a more perfect mastery of the language. "It is now about two years since M. Mieille, a professor in the Lycée of Tarbes, Hautes-Pyrénées, while in England, devised a method of international correspondence between students and teachers in France and England, which has been warmly received by educators and students in those two countries, and several thousands on either side of the channel are now entered upon the lists and mutually rendering each other great aid in becoming familiar with their respective languages. . . . The method of procedure may be simply described thus: Let those schools, colleges, or individuals who wish to begin this system send the names, ages, and addresses of those who wish to correspond to the following well-known firms in Paris: For young students, send to MM. Armand Colin et Cie., No. 5 rue de Mezières, Paris, and for older students, teachers, or other mature persons, address Libraire Hachette, 79 Boulevard Saint-Germain, Paris. These firms will give prompt attention to such requests, assigning to each person whose name, etc., is sent, a suitable correspondent; and these French correspondents write the first letter, in French, to their American friends, who on receiving the letters promptly reply in English. After these first letters the next letter from France

is written in English, and the second letter from America is written in French. The correspondence thus commenced is continued as begun, alternating the two languages; also all letters received which are written in the language of the receiver are returned carefully corrected to the writer. Thus, if letters are filed, at the end of the year each student has model letters in the foreign tongue, and his own corrected letters for careful study. In Swarthmore College, Pennsylvania, about thirty students are enrolled as correspondents. The letters as received are read aloud in class, sometimes translated, sometimes in French, and are made most interesting topics for the lesson of the day. No one who has not tried the system can fully realize the new life and spirit that are thus infused into the class. Instead of being a dry and dull grammatical lesson, with little direct practical bearing upon daily life, the language is seen at once to have a life and meaning before little expected by the student."

The Liquefaction of Hydrogen.—At a recent meeting of the Royal Society, Professor Dewar read a paper describing the method by which on Tuesday, May 10th, he had succeeded in liquefying hydrogen, the last of the so-called "permanent gases." The apparatus used was a year in building, many slight but important details going to make up the final successful machine. The hydrogen was cooled to —205° C. and then allowed to escape continuously under a pressure of one hundred and eighty atmospheres from the nozzle of a coil of pipe at the rate of ten to fifteen cubic feet a minute, into a vacuum vessel doubly silvered, which was itself surrounded with a space kept below —200° C. With these arrangements liquid hydrogen began to drop from this vessel into a second vacuum space, doubly isolated by being inclosed in a third, and in five minutes twenty cubic centimetres of liquid hydrogen were collected. The yield of liquid was about one per cent of the gas. The liquid was clear and colorless and showed no absorption spectrum. When a long piece of glass tubing sealed at one end and open to the air at the other was immersed in the liquid hydrogen, solid air immediately appeared in it; and when a specimen of purified helium in a sealed tube was immersed, a distinct fluid was seen to collect in it. It would seem from this that there is little difference between the boiling points of helium and hydrogen. Professor Dewar pointed out that all known gases had now been condensed into liquids which could be manipulated at their boiling points under atmospheric pressure in suitably arranged vacuum vessels, though even so great a man as Clerk Maxwell had doubts as to the possibility of ever liquefying hydrogen. With liquid hydrogen as the cooling agent a temperature could be reached within 20° or 30° of the zero of absolute temperature, and its use would open up an entirely new field of scientific inquiry. M. Moissan read a similar paper before the Academy of Science in Paris early in May. It is also claimed that Professor Olszewski had previously determined the boiling point and critical temperature of hydrogen.

Grasses in Iowa, Nebraska, and Colorado.—Prof. L. H. Pammel, in his Notes on the Grasses and Forage Plants of Iowa, Nebraska, and Colorado, remarks on the different aspects the forage question in central Iowa presents now from what it did fifteen years ago. At that time considerable areas of unbroken sod still remained. Now the wild prairies have ceased to be a factor in the production of hay. They have given way to cultivated fields and pastures, and the few small unbroken areas occurring here and there are chiefly confined to the small drainage basins between the hills where moisture interferes with proper cultivation. The standard and other cultivated grasses that have been introduced have been tried with varying success; the native species vary in quantity and quality in different parts of the State. Several native leguminous plants have more or less value for fodder. The pastures suffer deterioration from overstocking and the growth of weeds. The grasses can not endure the close grazing and extensive trampling to which they are subjected, and die out, and weedy annuals plant themselves in their places, or the native ragweeds and verbenas spread and occupy the soil. All of these have become so plentiful that farmers note their more frequent occurrence than in former years. In Nebraska the grasses do not grow so luxuriantly season

after season as in Iowa, but the climate is more favorable for winter grazing, and there are many valuable species of native forage plants. In the semiarid regions of northeastern Colorado, the areas that were at one time cultivated have been allowed to revert to grasses, and the region has become famous as a stock country and is seemingly prosperous. In the country north of this, though the rainfall is limited, there are thousands of acres of fine meadow and grazing lands covered with a dense growth of grama grass. A large number of native grasses occur along irrigating ditches and streams, and many of them are highly nutritious. In the mountain regions, the foothills and higher mountain slopes produce a large number of valuable grasses, increasing in variety and richness with the ascent. Cattle are raised for beef, and dairying is carried on at the lower altitudes.

Our Native Gems.—From Mr. G. F. Kunz's report on the production of precious stones in the United States during 1896 we learn that true rubies have been found in the Corvee Valley, Macon County, N. C., in a manner of occurrence new to science, along with some very beautiful almandine garnets, corundum, gold, and other minerals of value. The best ruby crystal so far obtained weighs about six and a half carats. The sapphires in Montana have already been mentioned in The Monthly. Many fine crystals of beryl of gem value were found in Topsham, Maine, one twelve inches long and two inches in diameter. Other beryls were found at Hampden, Md., and Bakersville, N. C. A topaz was found in Idaho, about one hundred miles north of Boisé, and other topazes at Thomas Mountain and Simpson Springs, Utah. Tourmalines continue to be found at Paris, Maine, Haddam, Conn., and Waynesville, N. C. Olivine chrysolite and peridot are reported from Webster, N. C.; several varieties of garnet in Tulare County, Cal.; quartz crystals with fluid inclusions in Herkimer County, N. Y.; thousands of pounds of crystals of quartz in three counties of Arkansas, and other quartz near Cheyenne Pass, Wyoming, Whitehaven, Pa., at Autauga, Ala., and in Tulare County, Cal.; and quartz of different varieties at localities in North Carolina, Idaho, the Black Hills, New Mexico, and Washington; rutilated amethyst crystals in the Black Hills, and Goochland County and Livingston, Va.; chrysoprase at Visalia, Cal.; agate in Wyoming and at Soldier's Delight, Md.; opal at Bare Hills, Md., and Clover Creek, Idaho; wardite, a new "semi-precious" stone, in Utah; Smithsonite, a golden-yellow carbonate of zinc, locally known as "yellow fat," in beautiful mammilar masses in the Morning Star Mine, Yellville, Ark. Besides these are the fossilized woods, which have become generally known. Mr. Kunz's report for 1895 mentions also moss agate at two localities in Wyoming and two in California; labradorite at Toronto, Ont., and Mont Shavano, Cal.; rhoderosite in Colorado and Utah; realgar at the Golden Gate Mine, Utah; and the largest black tourmaline known, monazite, and xenotine on Manhattan Island.

The Growth and Decay of Nations.—The following paragraphs are taken from an article in a recent Contemporary Review, by Thomas Hodgkin, D. C. L.: "It is a question which has been often discussed, and to which men's minds have often turned of late, whether states and nations have, like individual men, their necessary periods of infancy, childhood, adolescence, and old age, to be followed, in the one case as in the other, by death, which is the end of all. The analogy between the state and the man at once suggests itself; but analogy is not in itself proof: on the contrary, it is sometimes one of our most misleading guides. That many great and strong empires have faded and vanished away is obvious.

> "'Assyria, Greece, Rome, Carthage, what are they?'

"But are we therefore forced to conclude that all states must die? Is it incumbent on the wise statesman to look forward to his country's death and to make provision for that event, as it is incumbent on each one of us individually to 'consider our latter end,' and so to order our affairs that those who come after us shall not have occasion to curse either our improvidence or our over-caution? I suggest the question without presuming fully to answer it. Only I may hint that it does seem as if, for some reason or other, there were a greater tenacity of life among the nations of modern Europe than there was in most of the nations of

antiquity; and that I do not see why, for practical purposes and for its influence upon conduct, we need look forward to an inevitable death of our country any more than to that death of the physical universe which, as philosophers tell us, is probable, perhaps inevitable, in some incalculably distant future age. But if death is not the inevitable doom of a state, it is quite certain that states are liable to something which we may without any strained analogy call disease. Looking back over the pages of history we can easily recall instances of states which have had their energies wasted by fierce attacks of fever; states which have suffered from raving madness; states which have overtasked their powers by undertaking labors beyond their strength and have died of overwork; states which have dropped noiselessly out of the ranks, the victims of senile decay. Since, then, there is such a thing as national disease, and since it threatens primarily the happiness and eventually the life of the state, a serious student of history will be ever on the alert to discover the symptoms of disease in the past life of nations, and to trace the manner of its working, in order that he may combat its first manifestations in his own country. In fact, I think we may say that this work, the study of political health and disease, is emphatically *the* business and the *raison d'être* of all history."

Adam Smith and Astronomy.—Mr. W. T. Lynn calls attention in a recent issue of The Observatory to the fact, not generally known, that Adam Smith, famous through his Wealth of Nations, was something of an amateur astronomer. He wrote a history in his younger days of astronomy up to the time of Newton. It was published in 1795, five years after the author's death. In view of the care which this author took to destroy all his manuscripts which he did not deem worthy of publication, his opinion of this *brochure* is of interest. The following paragraph occurs in a letter of his to Hume, dated at Edinburgh, April 16, 1773: "As I have left the care of all my literary papers to you, I must tell you that, except those which I carry along with me, there are none worth the publication but a fragment of a great work which contains a history of the astronomical systems that were successively in fashion down to the time of Descartes. Whether that might be published as a fragment of an intended juvenile work, I leave entirely to your judgment, though I begin to suspect myself that there is more refinement than solidity in some parts of it." The full title is The Principles which lead and direct Philosophical Enquiries, illustrated by the History of Astronomy."

The New York State Library.—The New York State Library, according to its last annual report, grew in 1897 from 198,700 volumes to 207,934 volumes in the State Library proper, with 33,739 volumes in the traveling and extension libraries, making with the 108,111 duplicates a total of 349,784 volumes. The policy is fairly started of building up one of the strongest education libraries; and the State has the best general law library in the country. Any registered physician in the State may borrow from the medical library without expense except for transportation. The use of the library in the evening has increased fivefold during the past five years. Scholars from a distance are more and more coming to Albany to make investigation; and lawyers and public men after other business is transacted often find the evening use of the library advantageous. Books are more and more sent from the shelf to institutions and scholars in all parts of the State, a thirtyfold gain having been realized in this function since 1889. Besides distribution to clubs and individuals, 19,750 volumes of State publications were sent out through the library last year to permanent depositaries. The preparation of syllabuses as guides to study for university-extension lectures, clubs, and individual students is growing in importance and promises to become one of the recognized departments of the library work. The library school, which is claimed to be the first of its kind in the world, continues to grow in strength and reputation; and it has been necessary to increase its facilities. Its usefulness has been generally recognized by librarians—in other countries as well as this.

Advantages of Large Telescopic Glasses.—The principal advantages of a large telescopic object glass—forty inches aperture in

the special case as compared with a smaller one, ten inches—are summarized by Prof. George E. Hale as consisting of, first, its power of giving much brighter star images and thus of rendering visible faint stars that can not be seen with the smaller telescope; second, in the fact that it gives at its focus an image of the object enlarged in proportion to its greater diameter; and third, in its capacity of rendering visible as separate objects the components of very close double stars or minute markings upon the surface of a planet or satellite. The large glass has its disadvantages too, among the chief of which is that it requires better atmospheric conditions to bring out its best qualities. The discoveries of the fifth satellite of Jupiter and the two satellites of Mars were made with large telescopes, and could hardly have been made with smaller ones. Much fine detail on the moon which the author has never been able to see with the twelve-inch telescope is "clearly and beautifully visible" with the forty-inch. Micrometrical measures are effected with much more ease and certainty with the large telescope. "It is particularly in astrophysical research that a great telescope is advantageous. It is necessary in spectroscopic observation to have as much light as can be gathered into a single point, and for this a large glass is essential. It follows from these facts that great telescopes really have a mission to perform. While, on the one hand, they are not endowed with the almost miraculous gifts which imaginative persons would place to their credit, they do possess properties which render them much superior to smaller instruments and well worth all the expenditure which their construction has involved. In answering the question, 'Do large telescopes pay?' it is simply a matter of determining whether the work which can not be done without the aid of large telescopes is really worth doing."

New Features in School.—The report of the Superintendent of Schools of Springfield, Mass., tells of a new departure in the reading classes by substituting literary reading for the school readers of the old sort. "Ten years ago all the fourth and fifth readers were taken out of the schools, and literature and reading matter bearing directly on geography and history were introduced in their place. Since then all the third readers and nearly all the second and first readers have been displaced by reading matter which is intrinsically interesting to children. In point of quality, pupils in going through the grammar schools now read more good literature than pupils in any of the courses in the high school read a few years ago. Much of this literature is read in connection with the study of history." The superintendent expresses his belief that the time has come when no new schoolhouses shall be erected in the city without some provision for personal cleanliness in the way of facilities for bathing. This he regards as necessary for the health of the school, on account of the number of pupils who come from tenement houses and unsanitary quarters with skins in such a condition as to contaminate the air of the schoolroom. A school bath was first established in Göttingen, Germany, in 1883; and the example of that place has now been followed in about forty German, Swiss, and Scandinavian cities, where warm shower baths have been introduced into the common schools. At Charlottenburg, Prussia, the entire equipment of a bath accommodating fifty or sixty children an hour cost only three hundred and fifty-seven dollars. The study of music has been made elective in the Springfield school; and a department has been established in the high school, with the aim not of teaching the children to play or sing, but to appreciate the best classical music. The system of savings, auxiliary to the savings banks, established in the schools, works well, and the savings have materially increased. The teachers are supplied with stamps, which are sold to the children, and entries to their credit are made for the amounts. When the sum reaches a dollar, the child is urged to deposit it in one of the city savings banks, or he can draw it out for the purchase of necessaries.

Working of the Elective System in Colleges.—The results of the discussions concerning the elective system of study courses, as presented by Prof. A. P. Bingham in the Educational Review, have been its adoption into the common thought and the quiet extension of its range into our higher schools. "That can hardly be called a reputable college which has not admitted it in some meas-

ure. . . . In some cases the system has been adopted sparingly and timidly, as if under stress of competition. More often it has been received heartily up to a certain limit." The method of its application has, however, been very diversified, resulting in a great variety of schemes, a considerable number of which are reviewed and analyzed by the author. "No two colleges agree as to what studies are 'essential for all who are candidates for a liberal degree.' As to the working of the elective plan, the author believes that its risks are overestimated." No candid observer of college life can deny that free choice has promoted vital scholarship and hastened the growth of manly judgment in college students. It has revolutionized college teaching by sealing the doom of the lazy instructor. It has steadily extended its conquests, and is pushing its way into more colleges and over wider areas of the college course. That it should stand without important checks few would contend, but that the college student does not often abuse the elective privilege is, in the belief of the author, capable of proof. And a contribution to this proof is made from the records of the author's own college, Colgate University. Professor Bingham regards his study, as a whole, as indicating the sobriety, earnestness, and intelligence of the college man, and has no question that, "for the average man, sound habits of steady endeavor grow best in fields of choice."

MINOR PARAGRAPHS.

By availing himself of the properties of surface tension, M. Charles Henry has discovered a method of producing permanent coloration by the use of light-colors, without the aid of any pigment. Liquids having a superficial tension less than that of water are deposited on water in thin layers, where they reflect the colors of the spectrum. By whistling over this layer we obtain for each tone a vibration which is responded to by a special coloration, and a kind of molecular landscape is produced. The liquid, however, soon evaporates, and the play of colors vanishes. In order to preserve the colors, a fixed excipient is introduced into the liquid, which will retain the thickness of the pellicular layer, and the colors as well, after the essence has evaporated. Some resin or coal-tar substance is used for this, giving permanence to the pellicle and the picture. M. Henry has further devised a process for producing this pellicle and picture upon a solid foundation, as of wood, glass, or paper, and even for accomplishing it by mechanical processes. The nature of the ground in which the picture-pellicle is laid has much to do with its character. Dark grounds give intense colors, white grounds lighter ones, and grounds of intermediate colors various shades. The process is called *iri chromatime*.

THE images left by uranium upon a sensitive plate locked up with it in the dark may be regarded as an effect of the fluorescent property that metal is known to possess. Dr. Russell has, however, described to the Royal Society experiments from which it appears that mercury, zinc, magnesium, cadmium, aluminum, nickel, pewter, bismuth, lead, tin, antimony, and cobalt give out radiations capable of affecting the sensitive plate, and will leave images of themselves after standing upon one in the dark for about a week, although they possess no evident luminosity. Gold, platinum, and iron exhibit little or no power of the kind. A figure scratched upon the polished face of a sheet of zinc repeated itself. The interposition of a coat of varnish between the metal and the plate served to increase the effect, while glass, which makes no difference when uranium is applied, stopped the action with the other metals. Some non-metallic substances, such as straw, wood, charcoal, and printer's ink, presented the same property of leaving images. A section of young larch wood printed its formation clearly on a plate, so that the rings and bark could be made out. In many cases the activity was increased by heating the body, and diminished by cooling it.

A SILICIFIED tree is described by Lewis Woolman in the Report of the Geological Survey of New Jersey which lies in the orange-colored sand near Lindenwold in that State. The farmer of the land having regularly plowed up pieces of silicified wood, Mr. Woolman and his friends dug for the

stump. It measured seven feet six inches across at the base, which had been much broken by the plow, tapering to five feet two inches twelve feet higher up. Beyond this the central part of the trunk was missing, but the outer parts continued as two parallel arms, in line with the lower part of the trunk, to a total length of twenty-six feet. The silicification was perfect, and the rings of annual growth were plainly shown. An average of seventeen annual rings to the inch was determined, and the age of the tree when it fell was approximately estimated at six hundred years. Fragments split lengthwise and those broken directly across showed beautifully the structure of wood, and this is more minutely defined under the microscope. The orange-colored sand bed in which the trunk was buried, and the grounds of lighter yellow that overlie it near by, are known to have at least a local wide distribution.

NOTES.

THE general character of London weather is rather strikingly brought out by the records of the Greenwich meteorological department for 1897. The total record of sunshine for 1897 was 1,543 hours, divided as follows:

January.....	19.8	July.....	252.7
February.....	34.1	August.....	219.8
March.....	123.4	September....	114.5
April.....	144.7	October.....	111.7
May.....	251.6	November....	41.7
June.....	178.3	December....	50.3

The mean temperature for the year was 50.3°; highest, 90.2° on June 24th; lowest, 23.3° on December 24th. The rainfall was about seventeen inches, being seven inches less than the preceding fifty years' average.

IT is shown in a paper by Mr. Henry C. Mercer that the mediæval art of *Fractur* or illuminative writing was systematically prosecuted in Pennsylvania as late as 1854, and that survivals of stated instruction in it can be traced to the winter of 1896–'97. Illuminated song books, title-pages to small song books, rewards of merit on loose leaflets, baptismal certificates, and marriage and burial registers constitute the chief specimens of this sort of work.

THE working of certain factors of evolution upon a human race is illustrated in Mr. G. A. Dorsey's paper on the Geography of the Tsimshian Indians. Although the members of this tribe to-day are only a remnant of the stock as it existed in 1850, they seem to be holding their own in point of population, while some of the other coast stocks are diminishing very rapidly. They are nearly all Christianized, wear European clothing, and work in the salmon canneries during the summer months. Yet their ultimate absorption and extinction are only matters of time. The new villages, and especially the canneries, are bringing the different stocks of the coast into more and more intimate relations, and this results in the disappearance of pure types. The introduction of the Chinese element may further complicate matters.

M. DENIKER, of the Museum of Natural History in Paris, has received from Corea three hundred and seventy-five specimens of roots, seeds, fruits, etc., represented in the pharmacopœia of the country as sovereign remedies against various diseases. There are also among them powders of soapstone, sand, and other mineral substances. All are enveloped in complicated wrappers inscribed with Corean and Manchu formulas. A manuscript containing a list of a hundred and ten medicines which can be manufactured with the drugs has also been sent to the museum. It gives, in connection with each formula, the name of the disease for which the remedy is to be administered. There are remedies for cold in the head, indigestion, headache, ill humor on getting up in the morning, and indisposition after "making a night of it."

A SPECIES of ant in Victoria, Australia, is described by Mr. J. C. Goudie, which keeps in close confinement a mealy aphis that feeds on the stems of eucalyptus, around and over which it constructs a dome of pieces of grass, etc., that holds the aphis imprisoned and keeps other ants away. In front of the door of this covering, if it has one, two sentinel ants are posted, which vigilantly guard the opening. Each inclosure generally contains from three to a dozen aphides, and about as many ants. When the author broke into some of these structures to inspect them more closely, the ants at once seized their aphides and carried them off.

SIR GARDNER WILKINSON observed more than fifty years ago that the ancient Egyptians had a keen appreciation of the comic, and published a considerable number of drawings from the monuments that fully established the correctness of his view. Further illustrations of the fact, given by Herr Emil Brugsch Bey, are published in French and German papers as new discoveries. A newly exhumed papyrus of the twenty-second dynasty contains humorous sketches of cats and rats, in which the cats act like rats and rats like cats. In one design, a rat dressed as a grand lady is served by a servant cat, who offers her a mirror. In the next scene a rat poses as a young Egyptian dandy, while his valet cat dresses his beard and adjusts an immense wig upon his head. In a third scene a cat is officiating as nurse to a young rat. All the pictures are colored.

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